

**DEPARTMENT OF TRANSPORTATION**

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February 20, 2004

04-SF-80-13.2/13.9  
04-0120F4  
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Addendum No. 19

Dear Contractor:

This addendum is being issued to the contract for construction on State highway in SAN FRANCISCO COUNTY IN SAN FRANCISCO FROM 0.6 KM TO 1.3 KM EAST OF THE YERBA BUENA TUNNEL EAST PORTAL.

Submit bids for this work with the understanding and full consideration of this addendum. The revisions declared in this addendum are an essential part of the contract.

Bids for this work will be opened on May 26, 2004.

This addendum is being issued to revise the Project Plans, the Notice to Contractors and Special Provisions, and the Proposal and Contract.

Project Plan Sheets 48, 49, 50, 51, 53, 55, 56, 57, 60, 63, 64, 65, 407, 409, 410, 412, 511, 519, 520, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 583, 584, 585, 624B, 716, 723, 728, 731, 736, 743, 744, 745, 746, 747, 748, 749, 754, 760, 761, 764, 766, 767, 768, 769, 771, 782, 848, 849, and 850 are revised. Half-sized copies of the revised sheets are attached for substitution for the like-numbered sheets.

Project Plan Sheets 747A and 1121A are added. Half-sized copies of the added sheets are attached for addition to the project plans.

Project Plan Sheets 1121, 1122, 1123, and 1124 are deleted.

In the Special Provisions, Section 1, "SPECIFICATIONS AND PLANS," "AMENDMENTS TO JULY 1999 STANDARD SPECIFICATIONS," Section 52, "REINFORCEMENT," is revised as attached.

In the Special Provisions, Section 2-1.08, "SMALL BUSINESS AND DISABLED VETERAN BUSINESS ENTERPRISE UTILIZATION AND REPORTING," is replaced with Section 2-1.08, "DISADVANTAGED BUSINESS ENTERPRISE, SMALL BUSINESS AND DISABLED VETERAN BUSINESS ENTERPRISE UTILIZATION," as attached.

In the Special Provisions, Section 5-1.077, "PREFERENCE FOR U.S.-FLAG AIR CARRIERS," is added as attached.

In the Special Provisions, Section 5-1.12, "PROJECT INFORMATION," subsection "INFORMATION HANDOUT," subsection "District Materials Information," item H is deleted.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 5-1.12, "PROJECT INFORMATION," subsection "INFORMATION HANDOUT," subsection "District Materials Information," under Items available for inspection, the following item is added:

"Q. Forms for monthly reporting of Disadvantaged Business Enterprise, Small Business and Disabled Veteran Business Enterprise participation."

In the Special Provisions, Section 5-1.14, "MONITORING," is deleted.

In the Special Provisions, Section 5-1.16, "INTERGRATED SHOP DRAWINGS," is revised as attached.

In the Special Provisions, Section 5-1.27, "PAYMENTS," is revised as attached.

In the Special Provisions, Section 5-1.39, "DAMAGE BY STORM, FLOOD, TSUNAMI OR EARTHQUAKE," is replaced with Section 5-1.39, "INSURANCE," as attached.

In the Special Provisions, Section 10-1.10, "TRANSPORTATION FOR THE ENGINEER," the eighth paragraph is deleted.

In the Special Provisions, Section 10-1.11, "PROGRESS SCHEDULE (CRITICAL PATH METHOD)," subsection "BASELINE SCHEDULE," the last paragraph is revised as follows:

"The Engineer will be allowed 30 days to review and accept or reject the baseline project schedule submitted. Rejected schedules shall be resubmitted to the Engineer within 5 days, at which time a new 15-day review period by the Engineer will begin."

In the Special Provisions, Section 10-1.11, "PROGRESS SCHEDULE (CRITICAL PATH METHOD)," subsection "TIME IMPACT ANALYSIS" is revised as follows:

**"TIME IMPACT ANALYSIS**

When the Contractor requests a time adjustment due to contract change orders or delayed activities or if the Contractor or the Engineer considers that an approved or anticipated change will impact the critical path or contract progress, the Contractor shall submit to the Engineer a written Time Impact Analysis illustrating the impact of each change or delay to the current contract completion date or milestone completion date, utilizing the current accepted schedule. Each Time Impact Analysis shall include a schedule update (an accepted schedule with a data date within the previous month of the event) reflecting the "before conditions", and schedule revision reflecting the "after condition", both with the same data dates, demonstrating how the Contractor proposes to incorporate the change order or delay into the current schedule. The schedule revision shall include the sequence of activities and any revisions to the existing activities to demonstrate the impact of the delay, or change into the schedule. The Time Impact Analysis shall also include proposed mitigation measures or work arounds including but not limited to alternate work calendars, re-sequencing of other activities, or performing work activities out-of-sequence to minimize the impact of the change order or the delayed activities.

Each Time Impact Analysis shall demonstrate the estimated or actual time impact based on the events of delay, the estimated or actual date of the contract change order work performance, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the current schedule in effect at the time the change or delay was encountered.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining float along the critical path of activities from the time of actual delay, or from the time the contract change order work is performed. Mitigation measures shall be included in the analysis. The Time Impact Analysis shall also consider the use of State owned float as a mitigation measure. Time extensions will not be granted nor will delay damages be paid unless:

- A. The delay is beyond the control and without the fault or negligence of the Contractor and its subcontractors or suppliers, at any tier; and
- B. The delay extends the actual performance of the work beyond the currently approved contract completion date.
- C. The delay impacts a fabrication or construction activity – delays to the Contractor's submittal or shop drawing process must impact a successor fabrication or construction activity. The Time Impact Analysis shall be based on the impact to fabrication or construction activities.

Time Impact Analyses shall be submitted within 15 days after the delay occurs or after initiation of the contract change order. The schedule files will be submitted on electronic medium along with the Time Impact Analysis, which shall include a narrative description of the delay, its impact on contract completion or milestone dates and proposed mitigation measures. Mitigation measures utilized to minimize the impact of the change order or delay shall include but are not limited to work arounds, re-sequencing of work, alternate work calendars, increased resources, expedited procurement and use of State owned float.

A response to each Time Impact Analysis by the Engineer will be made within 15 days after receipt of the Time Impact Analysis. The Engineer's review shall utilize actual data unless it is appropriate to use estimated data. Resolution of each Time Impact Analysis by the Engineer shall be completed after all effects of the disruption are documented, which may include mitigation measures. A copy of the Time Impact Analysis accepted by the Engineer shall be returned to the Contractor and the accepted schedule revisions illustrating the impact of the contract change orders or delays shall be incorporated into the project schedule during the first update after acceptance. Until such time that the Contractor provides the analysis, the Engineer may, at his option, construct and utilize the project as-built schedule or other method to determine adjustments in contract time."

In the Special Provisions, Section 10-1.14, "WORKING DRAWING CAMPUS," is revised as attached.

In the Special Provisions, Section 10-1.16, "WORKING DRAWING SUBMITTAL SCHEDULE," the first sentence of the fourth paragraph is revised as follows:

"Within 90 days after approval of the contract, the Contractor shall submit to the Engineer for acceptance the working drawing submittal schedule in conjunction with the Baseline Schedule."

In the Special Provisions, Section 10-1.36, "TEMPORARY TOWERS," subsection "TEMPORARY TOWER DESIGN," subsection "Design Load Combinations" is revised as follows:

"Design Load Combinations for Load Factor Design  
Temporary towers shall be designed using the following load combinations:

- 1.1 DL + 1.3 LL
- 1.0 (DL + LL + 0.5 Wind + Current + Vessel Impact)
- 1.0 (DL + LL + EQ)
- 1.0 (DL + LL + Wind)."

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 10-1.38, "HIGH STRENGTH PRESTRESSING ROD (75MM)," is revised as attached.

In the Special Provisions, Section 10-1.40, "CONCRETE STRUCTURES," subsection "MASS CONCRETE," subsection "Thermal Control Plan", the eleventh paragraph is revised as follows:

"After completion of the mass concrete element, the Contractor shall remove all formwork, equipment and materials from the mass concrete element and clean the surface for the Engineer to measure the crack intensity. Surface crack intensity will be determined after monitoring shows the maximum allowable temperature difference, as specified in the Thermal Control Plan, is greater than the difference between the interior concrete temperature and the average daily temperature for three consecutive days. Interior concrete temperature and average daily temperature determinations shall conform to the requirements of the Thermal Control Plan and these specifications. Cracking shall be considered excessive if a surface crack intensity on any face of a concrete surface where cracks greater than 0.15 mm in width measure more than 1.0 m in cumulative length within any 2 m square area or where individual cracks greater than 0.15 mm in width measure more than 300 mm in length."

In the Special Provisions, Section 10-1.40, "CONCRETE STRUCTURES," the following subsection is added after the subsection "ELASTOMERIC BEARING PADS":

**"DRILL AND BOND DOWELS**

Drilling and bonding dowels shall conform to the details shown on the plans, the provisions in Section 83-2.02D(1), "General," of the Standard Specifications, and these special provisions.

Dowels shall conform to the provisions for bar reinforcement in "Reinforcement" of these special provisions.

If reinforcement is encountered during drilling before the specified depth is attained, the Engineer shall be notified. Unless the Engineer approves coring through the reinforcement, the hole will be rejected and a new hole, in which reinforcement is not encountered, shall be drilled adjacent to the rejected hole to the depth shown on the plans.

Unless otherwise provided, dowels to be bonded into drilled holes will be paid for as bar reinforcing steel (bridge)."

In the Special Provisions, Section 10-1.40, "CONCRETE STRUCTURES," subsection "MEASUREMENT AND PAYMENT," the following paragraph is added after the last paragraph:

"Full compensation for drilling holes, including coring through reinforcement when approved by the Engineer, and bonding dowels shall be considered as included in the contract price paid per cubic meter for structural concrete, bridge and no separate payment will be made therefor."

In the Special Provisions, Section 10-1.41, "SPHERICAL BUSHING BEARING (PIER E2)," is revised as attached.

In the Special Provisions, Section 10-1.42, "FURNISH SPHERICAL BUSHING RING BEARING (HINGE K)," is revised as attached.

In the Special Provisions, Section 10-1.43, "TOWER CROSS BRACING SPHERICAL BUSHING BEARING," is revised as attached.

In the Special Provisions, Section 10-1.441, "LUBRICANT AND TEST," is added as attached.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 10-1.461, "SEISMIC JOINT," the third paragraph is revised as follows:

"Unless otherwise directed by the Engineer, prior to submitting working drawings, the Contractor shall inspect the Hinge A blockouts in the adjacent Skyway Structures constructed by others in Contract No. 04-012024. The Contractor shall submit to the Engineer an inspection report for review and approval. This inspection report shall be titled "Skyway Blockouts Inspection Report" and shall include the actual blockout sizes; potential interference with the blockout reinforcement and seismic anchorages shown on the plans; any conflicts with the details shown on the plans; and recommendations to resolve the conflicts. The Contractor shall allow the Engineer 10 working days to review and approve the "Skyway Blockouts Inspection Report."

In the Special Provisions, Section 10-1.49, "REINFORCEMENT," is revised as attached.

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "WORKING DRAWINGS," the following paragraph is added after the last paragraph:

"The shop practices and the working drawings need not be submitted at the same time."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "ERECTION PLAN," the sixth paragraph is revised as follows:

"The Contractor shall readjust the suspender lengths by shimming at all panel points based on a final erection analysis that includes the measured reactions from Hinges A and K or as directed by the Engineer."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "WEIGHT CONTROL," the fourth paragraph is revised as follows:

"Weight reports shall be submitted using a format described in the approved weight control procedure. These reports shall include the weight of all installed components including utilities, platform barriers, counter weight and roadway wearing surfaces including the range of uncertainty in the estimated final weight. The design weights used in the Contractor's erection analysis shall consist of the nominal weights taken off the fabrication drawings increased by 3%."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "CASTINGS" is revised as follows:

#### **"CASTINGS**

Castings shown on the plans as "Structural Casting Grade 345," "Structural Casting Grade 415," and "Structural Casting Grade 550" shall conform to the requirements of these special provisions. Castings for suspension, hangar and other cable system components shall conform to the requirements in "Cable System" of these special provisions.

At the option of the Contractor, the remaining portions of the casting components may be redesigned as castings in accordance with the requirements of this section. Any use of castings for other structural components shall follow the requirements of this section, and a detailed, written proposal shall be submitted to the Engineer for prior approval. The Contractor shall submit for the approval of the Engineer, working drawings for castings in accordance with the requirements of "Working Drawings," of these special provisions. Working drawings for castings shall include, at a minimum, detail drawings of the redesigned cast configuration showing equivalency to the details shown on the plans.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

The Contractor shall perform finite element complex heat flow analysis for each pattern including all risers and gates that demonstrates that final solidification will occur outside of the final casting. This analysis shall also be used to confirm inspection procedures by identifying the locations of likely defects such as shrinkage, hot tears and porosity. The analytical solid model shall be sufficiently detailed and accurate to demonstrate complete coverage of ultrasonic examination by including the ability to superimpose ultrasonic beam paths on the model. Coverage may be demonstrated by drawing beam paths on printed sections of the solid model. The analytical model and supporting calculations shall be submitted to the Engineer for approval in accordance with the "Working Drawings" section above.

The Contractor shall submit a manufacturing procedure to the Engineer for approval that shall specify all chemical, heat treatment, testing, visual and nondestructive inspection and quality control requirements. Quality control requirements and manufacturing facilities shall be subject to a quality audit as specified in Section 8-4 "Steel Audits" of these special provisions and include the additional requirements of this section.

Castings shall be manufactured to the requirements in ASTM Designation: A148 with the following Supplementary Requirements as modified herein: S1, S4, S5, S6, S7, S8 (Individually marked), S9, S12, S15, and S16.

The manufacturing procedure shall define the specific chemistry, including tolerances for each element. The alloy shall conform to the general limits in the following table, except alternative alloys that meet the required mechanical properties and other requirements herein, that have similar or better weld ability, and that have a documented history of successful application may be submitted for approval by the Engineer. The steel shall be fully killed and made to fine grain practice.

ELEMENT (Max. or range)	BASE GRADE	C	Si	Mn	P	S	Ni	Cr	Mo
Structural Casting Grade 345	A148M, Gr. 550- 345	0.20	0.60	1.50	0.025	0.025	1.2	0.50	0.25
Structural Casting Grade 415	A148M, Gr. 620- 415	0.28	0.80	1.00	0.025	0.025	1.40- 2.00	0.55- 0.90	0.20- 0.40
Structural Casting Grade 550	A148M, Gr. 725- 585	0.24	0.50	0.55- 0.75	0.025	0.025	2.50- 3.50	1.35- 1.85	0.30- 0.60

ELEMENT (Max. or range)	BASE GRADE	Al	Cu	V	Cb	Ti	CE**
Structural Casting Grade 345	A148M, Gr. 550- 345	.010 – .060	0.30	0.03	0.03	0.05	0.65
Structural Casting Grade 415	A148M, Gr. 620- 415	.010- .030	0.50*	0.03*	0.03	0.05	0.90
Structural Casting Grade 550	A148M, Gr. 725- 585	.010- .030	0.20*	0.03*	0.03	0.05	-

Notes:

\* means not intentionally added.

\*\* The CE limit is only required for "Welded Cast Components" that are not fabricated by the foundry.  $CE = C + (Mn+Si)/6 + (Cr + Mo + V)/5 + (Cu + Ni)/15$

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

"Welded Cast Components" are defined as structural components that are fabricated by welding plates or other steel to castings designated by structural grade as shown on the plans.

Each casting shall be given either a double normalized heat treatment or a normalized plus quench and temper heat treatment at temperatures and times specified in the manufacturing procedure except the final tempering temperature shall not be less than 565 C. Specimens for mechanical testing shall be taken from a representative casting, a prolongation to the casting or a keel block. The test specimen block shall be in accordance with S15 of ASTM Designation: A148 (ASTM Designation: A781, Paragraph S15.3.1 option for a 375 mm by 375 mm by 125 mm maximum cast coupon size is acceptable), be poured from the same ladle and heat treated along with the castings that it represents. The test specimens shall meet the requirements in the table below.

	STRUCTURAL CASTING GRADE 345	STRUCTURAL CASTING GRADE 415	STRUCTURAL CASTING GRADE 550
Tensile Strength:	550 MPa – 690 MPa	620 MPa – 795 MPa	680 MPa – 840 MPa
Yield Strength:	345 MPa, Minimum	415 MPa, Minimum	550 MPa, Minimum
Elongation:	22%, Minimum	20%, Minimum	18%, Minimum
Reduction of Area:	35%, Minimum	35%, Minimum	30%, Minimum
Charpy V-Notch:	42 J, Minimum at 0° C	42 J, Minimum at 0° C	90 J, Minimum at 0° C

Each casting shall be visually examined 100% on all surfaces and shall be free of adhering sand, scale, cracks, shrinkage, unfused chills and hot tears and meet the Manufacturing Standardization Society of the Valve and Fittings Industry Inc. Publications (MSS) specification MSS-SP-55, "Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method". Machined surfaces shall be free of voids or other discontinuities that exceed the following: A maximum of one discontinuity within a radius of 150 mm that has a diameter not exceeding 3 mm within the saddle troughs or 5 mm elsewhere, a maximum depth of one half of the diameter, and a rounded shape with no sharp corners. Voids within the saddle troughs shall be filled during metallizing. All areas that are not shown as machined, but are designated as Level 1 on the plans shall be ground to a finish suitable for the magnetic particle, liquid penetrant and ultrasonic examinations required below.

Each casting shall be examined 100% on all surfaces by visible contrast, wet magnetic particle method to ASTM Designation: E709 on the final, as-finished surface. Visible contrast, dry powder method to ASTM Designation: E709 may be used on as-cast surfaces outside of Level 1 zones where no machining is required. The prod method shall not be used. Liquid penetrant examination to ASTM Designation: E165 may be used as an alternate to magnetic particle examination of the casting. Linear indications, defined as having a ratio of maximum to minimum dimensions greater than 3, tears and cracks will not be permitted. Indications less than 3mm for Level 1 zones and 6 mm elsewhere may be disregarded.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

Each casting shall also be volumetrically examined 100% by ultrasonic (UT) methods in accordance with a written procedure submitted with the manufacturing procedure. The procedure shall define calibrations, equipment and materials and shall include part-specific shooting sketches that demonstrate complete coverage of the full volume from two perpendicular directions. Coverage shall be compatible with locations identified as possible locations for defects based on the finite element heat flow analysis and the foundry practice. Ultrasonic procedures shall be based on ASTM Designation: A 609, "Standard Specification for Longitudinal Beam Ultrasonic Inspection of Carbon and Low-Alloy Steel Castings," using Procedure A, except supplementary angle beam examination to Supplementary Requirement S1 shall be performed on castings to ensure coverage from two perpendicular directions and on areas of castings where a back reflection cannot be maintained during straight beam examination, or where the angle between the front and back surfaces of the castings exceeds 15 degrees. The Distance Amplitude Curve (DAC) method shall be used for both straight and angle beam examinations. The DAC shall be constructed using a 3.0 mm diameter reference reflector hole for areas designated as Level 1 on the plans, and a hole diameter as specified in ASTM Designation: A 609M shall be used elsewhere. At each facility producing castings, ultrasonic test calibration blocks shall be poured from the first casting heat produced for this contract. Alternatively, reference blocks may be made from cast steel that has an acoustic response similar to the castings being examined as determined by the Engineer. The calibration blocks shall be made available to the Engineer for use in QA testing of the castings and to any subcontractors that perform ultrasonic testing on the castings. All calibration details shall be defined in the procedure.

The ultrasonic examination acceptance criteria shall be as follows: Within 30 mm of any final surface, unless otherwise noted on the plans, and at locations designated as Level 1 on the plans, indications that provide a response equal to or greater than the DAC and that are planar or that exceed the area specified in ASTM Designation: A 609, Table 2 for ultrasonic testing quality Level 1 will not be permitted. At all other locations, indications that provide a response equal to or greater than the DAC and that are planar or that exceed the area specified in ASTM Designation: A 609, Table 2 for ultrasonic testing quality Level 3 will not be permitted. The method for determining whether a reflector is planar shall be defined in the written procedure and shall be based on the high directionality of amplitude response for planar reflectors or other established technique.

Each casting shall be stenciled with its heat number and serial number.

Before casting, the Contractor shall produce 1/10 scale model of the tower saddle in wood or other material approved by the Engineer. The model shall show all details of the saddle including the location of weld, cast and plate materials and cast component parting lines. The model and manufacturing procedure shall be approved by the Engineer before the start of foundry production.

All areas of steel castings that will be in contact with other elements by welding, bolting or direct contact pressure shall be machined. The finish and surface texture of faying surfaces for bolted connections shall be suitable to obtain a Slip Critical bolted connection at Class B as defined by the RCSC specification.

Unless noted otherwise on the plans, the tolerance for linear dimensions of unmachined sections shall have a plus and minus tolerance (i.e., one half of the total tolerance range) in accordance with the following table:

Tolerance For Linear Dimensions (mm) Unaffected By Machined Surfaces

LINEAR DIMENSION, L	L < 60	60 ≤ L < 120	120 ≤ L < 250	250 ≤ L < 400	400 ≤ L < 630	630 ≤ L < 1000	1000 ≤ L < 1600	1600 ≤ L < 2500	2500 ≤ L < 4000	4000 ≤ L
TOLERANCE	4.5	5.5	7.0	9.0	11.0	13.0	16.0	19.0	31.0	47.0

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

Unless noted otherwise on the plans, the thickness tolerance of unmachined ribs shall have a minus tolerance of 3 mm and a plus tolerance in accordance with the following table:

Plus Tolerance For Thickness Of Ribs (mm) Where Both Faces Are Not Machined

THICKNESS RANGE	$t < 18$	$18 \leq t < 30$	$30 \leq t < 50$	$50 \leq t < 80$	$80 \leq t < 120$	$120 \leq t < 180$	$180 \leq t < 250$	$250 \leq t < 315$	$315 \leq t < 400$	$400 \leq t$
PLUS TOLERANCE	6.0	9.0	10.0	11.0	12.0	13.0	15.0	19.0	27.0	35.0

No coating or oil preservative shall be applied to a casting until that casting has been inspected and approved by the Engineer.

Minor defects may be removed by grinding or chipping without welding repair, in accordance with the following requirements:

- A. The removal of metal does not affect the strength, integrity or functionality of the casting, as determined by the Engineer.
- B. The remaining wall thickness is equal to or greater than the required minimum wall thickness.
- C. The surrounding metal is ground to a smooth contour with the elimination of apparent stress raisers.
- D. Specified tolerances on machined surfaces are satisfied.

Weld repairs may be permitted if qualified welding procedures are used that demonstrate Charpy V-Notch toughness of 34J at  $-30^{\circ}\text{C}$  in the weld metal and 34J for Structural Casting Grades 345 and 415, or 60J for Structural Casting Grade 550, at  $0^{\circ}\text{C}$  in the heat-affected zone in the final delivery condition. Weld procedure tests shall be qualified on 50 mm thick plates poured from the same heat as a production casting. Weld repairs shall be given a post weld stress relief heat treatment after all welding is complete. All proposed repair or upgrading welding procedure specifications (WPSs) shall conform to the requirements of ASME Boiler and Pressure Vessel Code, Section IX, as modified herein. Additional essential variables required for WPSs other than SMAW shall include welding travel speed (limited to  $\pm 10\%$ ), heat input (limited to  $+10\%$ ,  $-30\%$ ), and, for FCAW, the brand name of the electrode. Weld procedures with all supporting procedure qualification records (PQRs) shall be submitted in writing to the Engineer for each welding location, and shall include a description of the defect or other need for welding, the size and the shape of the excavation, the welding procedure specification, preheat and post weld heat treatment. If a second repair to base metal or heat affected zone is required at the same location, the Contractor shall include a metallurgical evaluation for the cause of the rejection in the submittal package to the Engineer for review and approval.

No welding or heat treatment will be permitted except with the specific written approval of the Engineer. In addition, the Contractor shall give the Engineer at least 12 hours notice prior to performing the work.

The exterior surfaces of the castings, after acceptance, shall be coated as specified in "Clean and Paint Structural Steel" and "Metallized Steel Surfaces" of these special provisions. The castings shall be carefully masked to avoid coating any high strength fastener contact surface, interior or other machine finished surface.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

At the time of assembly, the contact surfaces of the castings shall meet the machine finish requirements shown on the plans.

**Forging Alternative to Structural Castings**

At the option of the Contractor, castings shown on the plans as "Structural Casting Grade 345," "Structural Casting Grade 415," and "Structural Casting Grade 550" may be substituted with a hot-worked forging alternative conforming to the requirements for Structural Castings specified above, as modified herein. The manufacturing procedure shall be approved by the Engineer before any work commences.

GRADE	BASE SPECIFICATION	CHEMISTRY
Structural Casting Grade 345	ASTM A668	Structural Casting Grade 345
Structural Casting Grade 415	ASTM A668	Structural Casting Grade 415
Structural Casting Grade 550	ASTM A508M	Grade 4N, Class 1

Mechanical testing for tensile and toughness properties shall be performed for each heat and heat treatment lot on prolongations of production forgings or to separate forgings that are made from the same heat of steel, have received the same reduction and type of hot working, are of the same nominal thickness, and are heat treated in the same furnace charge as the forging(s) they represent. Properties shall be as specified for the Structural Casting grade.

Each casting shall be examined 100% by MT and by UT as described above with the following exceptions.

- A. MT shall conform to ASTM Designation: A788, S18 (no linear indication permitted that exceed 2 mm, where linear is defined as a maximum length to width ratio exceeding 3.0) and ASTM Designation: A275.
- B. UT shall conform to ASTM Designation: A788, S20 (method DA in 2 perpendicular directions) and ASTM Designation: A388.

**Fabrication of Welded Cast Components**

The Contractor shall submit to the Engineer for approval a document containing specific requirements for welding any casting that has an actual CE, as defined above, that exceeds 0.55. The submittal shall address welding heat input limitations, minimum preheat/interpass temperatures and post weld stress relief heat treatment (PWHT) temperature and time ranges.

Any fabrication of Welded Cast Components by the foundry, excluding repairs and upgrading as specified above, shall use welding procedures qualified to ASME Section IX, as modified above, or to AWS D1.5, as modified below, using both cast and ASTM Designation: A709 plates for the qualification welds. If the foundry fabricates a component by welding plate steel prior to final properties heat treatment, the weld procedure qualifications shall demonstrate that the properties of the plate, weld, and weld heat affected zone meet the requirements for the specified Structural Casting grade in the final delivery condition.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

For fabrication of Welded Cast Components by a facility other than the foundry, the foundry shall provide cast test plates to be used in weld procedure qualification testing in accordance with AWS D1.5, as modified herein and by the approved welding requirements document. The weld procedure test plates shall be the maximum thickness of plate to be welded or 50 mm, whichever is less, and shall conform to AWS D1.5, Figure 5.1. Unless otherwise specified, the tensile, bend, and Charpy V-Notch requirements shall meet those specified in AWS D1.5 for the plate steel. Charpy V-Notch tests shall be taken from the weld heat affected zone on the casting side and shall meet 34 J, minimum at 0° C. PWHT shall be performed on each Welded Cast Component after completion of all welding. The welding procedure specification shall conform to the AWS D1.5 Section 5.13 limitations of essential variables.

All complete joint penetration welds in Welded Cast Components shall be inspected 100% with UT and MT in accordance with AWS D1.5. All partial joint penetration and fillet welds shall be inspected 100% by MT in accordance with AWS D1.5."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "FABRICATION," subsection "Fabrication/Erection Procedure and Mock-Ups," the seventh paragraph is revised as follows:

"The completed steel mock-up shall be examined visually and by UT or RT and by Magnetic Particle (MT) using the nondestructive examination procedures that are proposed for production. Mock-up assemblies shall then be sectioned as directed by the Engineer to produce three macroetch samples per weld type that shall be evaluated per AWS D1.5. Approval of the fabrication and erection procedure and the nondestructive examination procedures shall be contingent on satisfactory results from the mock-up examination and destructive tests. Satisfactory mock-ups shall be defined as follows:

A. For the rib to deck PJP connections, satisfactory mock-ups shall be defined as mock-ups that meet the UT verification of depth of penetration and the macroetch criteria specified under "Welding of Closed Ribs to Box Shell Plates" below. No repairs of the rib to deck PJP connections will be allowed in the mock-up. Failure to achieve a satisfactory mock-up will require the Contractor to make any necessary adjustments to his fabrication procedures and then fabricate a new mock-up that will be subject to the same criteria.

B. All other mock-ups shall be defined as satisfactory when, either before or after repair as permitted herein, the mock-ups are free of defects as defined in the special provisions including all relevant sections of AWS D1.5 and demonstrate a procedure that will meet the requirements of the special provisions as determined by the Engineer. Minor weld repairs will be allowed except for the following circumstances:

1. A crack, as defined by AWS D1.5, is found visually or by MT.
2. Defects, as defined by AWS D1.5, that are found by UT or RT occur in greater than 10 percent of the cumulative length of any weld.
3. Distortion is caused that, in the opinion of the Engineer, cannot be repaired within the specifications and good engineering practice.
4. The mock-up, in the opinion of the Engineer, fails to demonstrate a procedure that will meet the specifications or fails to demonstrate a procedure that is repeatable in actual production.
5. Repair to the welds may not be made after macroetching. Cracks, lack of fusion, and lack of penetration, as defined in AWS D1.5, that are found during macroetch examination will result in an unsatisfactory mock-up.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

Should the Engineer deem the mock-up unsatisfactory, the Contractor shall revise and resubmit the Fabrication/Erection Procedure to correct the deficiency identified by the first mockup. A new mock-up, or partial mock-up, as determined by the Engineer, will be required after approval of the revised Fabrication/Erection Procedure."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "FABRICATION," subsection "Bolted Connections," the fifth paragraph is revised as follows:

"For the tower shaft bolted splice, all plies of the bolted connections for all faces shall be brought into alignment and full contact before tightening commences. The tower lift ends shall be milled to bear. Where mill to bear surfaces are specified on the plans or in these special provisions, the surfaces shall have a minimum of 75% of the bearing area in contact. The Contractor shall prepare a work plan that shall describe the procedure for meeting these requirements and that shall be approved by the Engineer before use. The work plan shall be demonstrated on the mock-up required above. The mating segments of each lift shall be mated at the fabrication site, and the required fit demonstrated, before moving each lift to the final assembly site."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "ASSEMBLY," subsection "Tower Lift Sections," the first paragraph is revised as follows:

"Tower lifts shall be in lengths as indicated on the plans. Exterior plates of the tower shafts shall be fabricated with direction of rolling aligned along the vertical direction of the tower. Within each lift, the number of transverse splices of the plates shall be minimized. Tower skin plate vertical seams shall be located a minimum of 100 mm away from longitudinal stiffeners unless otherwise shown on the plans. A full size template shall be used to control the tolerances between the tower shafts. A template is defined as a plate of a shaft that is used to produce identical cross-sections for the tower shafts."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "SHOP WELDING," subsection "Welding of Closed Ribs to Box Shell Plate," Item B, the second paragraph is revised as follows:

"Tack welding shall be considered as part of the weld qualification, including size and location of tacks, limits on essential variables and other qualification limitations."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "SHOP WELDING," subsection "Welding of Closed Ribs to Box Shell Plate," Item B, the fourth paragraph is revised as follows:

"At completion of welding of all closed ribs to deck plate, the welded panels shall be checked for straightness and other production tolerances. The welded, unstraightened panel shall be flat within 3 in 1000. If the unstraightened panel is not flat within 3 in 1000, new measures such as different prebending or fixturing, shall be proposed, and new trial panels welded. If the flatness requirement is satisfied, all remaining plates of the deck plate section shall be welded on to complete the steel mock-up. Testing of the closed rib welds shall be conducted after welding of all components of the mock-up have been completed."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "SHOP WELDING," subsection "Welding of Closed Ribs to Box Shell Plate," Item D, the third paragraph is revised as follows:

"If the flatness of more than one panel in five exceeds 6 in 1000 after welding, the Contractor shall propose a revised assembly procedure, such as a different amount of pre-bending, and shall demonstrate the revised method by welding a new panel in the presence of the Engineer."

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "SHOP WELDING," subsection "Welding of Closed Ribs to Box Shell Plate," the last paragraph is revised as follows:

"Production panels shall be nondestructively tested at the rate specified in these special provisions except that ultrasonic testing of the first two production panels shall include 100% of the tack welds. Ultrasonic testing of tack weld areas shall continue until no more than one in ten tack welds are rejected, after which random ultrasonic testing shall proceed at the rate indicated in the table specified in these special provisions. Ultrasonic testing of the PJP weld shall be in accordance with a written procedure that includes representative calibration standards with a 1.5 mm notch on the rib side and the plate side of the weld; that is demonstrated on a prototype panel segment that includes known flaws; and that is approved by the Engineer before use. Each ultrasonic technician shall be qualified using a mock-up weld with flaws that is approved by the Engineer."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "INSPECTION AND TESTING," in the table following the fourth paragraph, under section "1.BOX GIRDER: 1.1 Box Shell" in the ninth row the component "Longitudinal splice weld (Side plate C,E,G,H,I,L,M,N, "K" & "Vertical")" is revised as follows:

"Longitudinal splice weld (Side plate: C,E,G,H,I,L,M,N, "K" &"Vertical")	X				100%		(B & F are n/a)"
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In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "INSPECTION AND TESTING," in the table following the fourth paragraph, under section "1.BOX GIRDER: 1.1 Box Shell" in the twelfth row the component "Closed rib to shell plate: Tack welds automated; Tack welds not automated," is revised as follows:

"Closed rib to shell plate		X			15%	25%	UT shall include at least 15% of the tack welds"
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In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "INSPECTION AND TESTING," subsection "Pressure Test," the second paragraph is revised as follows:

"Five percent of ribs between bolted splices shall be leak tested. If leaks are detected, all of the rib spaces within the panel shall be subjected to leak testing. The Contractor shall repair the defects at the Contractor's expense."

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "FIELD WELDING," the fourth paragraph is revised as follows:

"For the field transverse orthotropic box girder welds, the following shall apply:

The Contractor shall perform all trial welding and procedure development prior to production field welding of transverse welds of the orthotropic box girder. During production field welding of the transverse joint, the Contractor shall completely weld, inspect and perform the NDT required at the first joint and submit the results to the Engineer for approval prior to proceeding to the next joint. If the NDT rejection rate exceeds 30% of the weld length, the Contractor shall revise his procedure and submit a formal report to the Engineer stating the reason for the defects and a plan to prevent these defects from recurring and to reduce the rejection rate to less than 10 percent of the entire welded length in subsequent welds. The Contractor will then be allowed to proceed to completely weld, inspect and perform the NDT required at the second joint with the revised procedures. If the NDT testing indicates that defects are present in less than 10 percent of the entire transverse weld length, the Contractor will be allowed to weld multiple transverse joints simultaneously. If during the welding of the second transverse weld joint, there are defects found in 10 percent or more of the weld joint length, the Engineer shall have the authority to stop work and request a formal report from the Contractor stating the reason for the defects and a plan to prevent these defects from recurring. No additional compensation will be made to the Contractor for any delays caused by this stoppage of work. If after completion of a weld joint with less than 10 percent defects, the Contractor chooses to change any essential variables in the welding process, and that process is approved by the Engineer, the Contractor may not weld multiple weld joints until one weld joint is successfully welded and NDT testing of the joint is performed that reveals defects in less than 10 percent of the length of the weld."

In the Special Provisions, Section 10-1.51, "STEEL STRUCTURES," subsection "FIELD WELDING," Item A of the eighth paragraph is revised as follows:

"A. Mechanized processes such as SAW or automated FCAW are required for field welding of the crossbeam and box deck plates unless otherwise approved by the Engineer."

In the Special Provisions, Section 10-1.52, "CABLE SYSTEM," subsection "MATERIALS AND FABRICATION," subsection "Cable Wrapping Wire," is revised as follows:

**"Cable Wrapping Wire**

Cable wrapping wire shall be S-shaped low carbon steel wire conforming to the requirements of Japanese Industrial Standard (JIS) G3505 and shall be hot dip galvanized to the requirements of ASTM Designation: A 475, Class A or equal.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

The S-shaped cable wrapping wire shall be manufactured by the following supplier:

VENDOR ADDRESS AND PHONE NUMBER
NIPPON STEEL CORPORATION 6-3 Otemachi 2-chrome Chiyoda-Ku, Tokyo 100-8071 Japan  TEL: 81-3-3275-6384 FAX: 81-3-3275-5971  Contact: Hajime Hosokawa

The galvanized wire shall have the following mechanical properties measured on the gross cross-sectional area:

Test	Minimum Number of Tests
Tensile Strength:	Fu > 540 N/mm <sup>2</sup>
Elongation	Not less than 1.5 percent in a 150 mm gauge length
Wire Size Tolerance	Width +- 0.15 mm, Thickness +- 0.08 mm, Gap of Lock +- 0.2 mm
Zinc Coating:	The zinc coating shall be uniform, show good ductility and adherence to the wire, and have a mass of not less than 280 g/m <sup>2</sup> .
Wire Straightness	No transverse kinks upon visual observations

Cable wrapping wire shall be wound in coils or on reels for protection and for shipping.

The following measurements and tests shall be performed on each coil of cable wrapping wire from each heat delivered. Selection of wires for testing shall be as directed by the Engineer and as follows:

Test	Minimum Number of Tests
Tensile Strength	One test piece taken from each end of every coil or fraction thereof
Elongation	One test piece taken from each end of every coil or fraction thereof
Wire Size Tolerance	One test piece taken from one end of every coil
Zinc Coating	One test piece taken from one end of every 5th coil or fraction thereof
Uniformity of Zinc Coat	One test piece taken from one end of every 5th coil or fraction thereof
Zinc Adhesion	One test piece taken from one end of every 5th coil or fraction thereof
Wire Straightness	One test piece taken from one end of every coil or fraction thereof

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

Cable wrapping wire shall be supplied to the job site in manufacturer's packaging. Open or damaged containers shall be removed from the job site. Cable wrapping wire shall be stored in accordance with the requirements in "GENERAL," subsection "Shipping, Handling, and Storage," of this section.

The price quoted by the manufacturer for S-shaped cable wrapping wire is \$6.20 per kilogram. The manufacturer's charge for a technical supervisor is \$1,400 per person per day, and \$28,000 per person per month (20 working days per month). These charges apply from the day of departure from Japan to the day of return back to Japan. The daily allowance for a technical supervisor, including accommodations, shall be \$125 per person per day. The charge for round trip airfare between Japan and San Francisco, California, United States, shall be \$4,200 per person. The FOB location is Yokohama, Japan. Quoted prices are in United States dollars.

The prices quoted will be firm for all orders placed on or before December 31, 2005, provided delivery is accepted within 120 days after the order is placed. The total price will be increased three (3) percent for orders placed after December 31, 2005, provided delivery is accepted within 120 days after the order is placed. The above prices include Japanese taxes, but do not include other taxes, freight, and insurance."

In the Special Provisions, Section 10-1.52, "CABLE SYSTEM," subsection "MATERIALS AND FABRICATION," subsection "Steel Castings," the second paragraph is revised as follows:

"Castings for cable bands, suspender separators and split collars shall conform to the requirements in ASTM Designation: A148M, Grade 550-345. Castings for suspender sockets and cable strand sockets shall conform to the requirements in ASTM Designation: A148M, Grade 620-415. Suspender rope sockets, cable strand sockets, and suspender rope separators shall be galvanized in conformance to the requirements of ASTM Designation: A123.

The Contractor shall determine the galvanizing thickness based on the chemistry of the casting prior to oversizing the inner threads. Tapping of internally threaded sockets shall be done after galvanizing and shall conform to the requirements for thread dimensions shown on the plans and overlapping allowances in ASTM Designation: A563."

In the Special Provisions, Section 10-1.58, "SIGN STRUCTURES," the twelfth paragraph is revised as follows:

"Circumferential welds and base plate to post welds may be repaired only one time without written permission from the Engineer. Sheet metal for enclosing the pentagon pole sign mounting structure shall be flat, hot-rolled sheets, that are in conformance with ASTM Designation A 1011, Grade 33, galvanized after fabrication."

In the Special Provisions, Section 10-1.62, "CLEAN AND PAINT STRUCTURAL STEEL," is revised as attached.

In the Special Provisions, Section 10-1.64, "CLEAN AND PAINT CABLE SYSTEM," is revised as attached.

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

In the Special Provisions, Section 10-3.16, "SUPERVISORY CONTROL AND DATA ACQUISITION REMOTE TERMINAL UNIT SYSTEM," subsection "PROGRAMMABLE CONTROLLER," subsection "Design and Manufacturer," the second and third paragraphs are revised as follows:

"The SCADA RTU system shall be obtained from the following supplier:

VENDOR ADDRESS AND PHONE NUMBER
INKELIS ASSOCIATES 6722 CORTE SANTA MARIA PLEASANTON, CA 94566 TEL: 925-485-0497 FAX: 925-485-0794 CONTACT: KAREN INKELIS

The unit prices quoted by the supplier for the SCADA RTU system are as follows:

	QTY	NTP 2004	NTP 2005	NTP 2006	NTP 2007	NTP 2008
RTU-10W & 10E	2	\$69,000	\$72,588	\$78,674	\$84,008	\$89,703
RTU-11W & 11E	2	\$67,000	\$70,484	\$76,393	\$81,573	\$87,103
#COM-4 Terminal Cabinet	1	\$ 3,850	\$ 4,050	\$ 4,390	\$ 4,687	\$ 5,005
#COM-5,6,7,8 Terminal Cabinets	4	\$ 3,875	\$ 4,077	\$ 4,418	\$ 4,718	\$ 5,038
#TEL-4,5,6,7,8 Terminal Cabinets	5	\$ 4,050	\$ 4,261	\$ 4,618	\$ 4,931	\$ 5,265
Testing and Checkout (hr)	64	\$ 7,900	\$ 8,311	\$ 9,008	\$ 9,618	\$10,270
Training (hr)	12	\$ 3,000	\$ 3,156	\$ 3,421	\$ 3,653	\$ 3,900
Software Programmer (hr)	24	\$ 4,200	\$ 4,418	\$ 4,789	\$ 5,114	\$ 5,460
Relay	24	\$ 720	\$ 757	\$ 821	\$ 877	\$ 936"

In the Proposal and Contract, in the Engineer's Estimate, Alternative 1 and Alternative 2, Items 70 and 71 are revised as attached.

To Proposal and Contract book holders:

Replace pages 31 and 39 of the Engineer's Estimate in the Proposal with the attached revised pages 31 and 39 of the Engineer's Estimate. The revised Engineer's Estimate is to be used in the bid.

Indicate receipt of this addendum by filling in the number of this addendum in the space provided on the signature page of the proposal.

Submit bids in the Proposal and Contract book you now possess. Holders who have already mailed their book will be contacted to arrange for the return of their book.

Inform subcontractors and suppliers as necessary.

Addendum No. 19  
Page 18  
February 20, 2004

04-SF-80-13.2/13.9  
04-0120F4  
ACBRIM-080-1(095)N

This office is sending this addendum by UPS overnight mail to Proposal and Contract book holders to ensure that each receives it. A copy of this addendum and the modified wage rates are available for the contractor's use on the Internet Site:

**[http://www.dot.ca.gov/hq/esc/oe/weekly\\_ads/addendum\\_page.html](http://www.dot.ca.gov/hq/esc/oe/weekly_ads/addendum_page.html)**

If you are not a Proposal and Contract book holder, but request a book to bid on this project, you must comply with the requirements of this letter before submitting your bid.

Sincerely,

ORIGINAL SIGNED BY:

REBECCA D. HARNAGEL, Chief  
Office of Plans, Specifications & Estimates  
Office Engineer

Attachments

## SECTION 52: REINFORCEMENT

Issue Date: November 06, 2003

The third paragraph in Section 52-1.04, "Inspection," of the Standard Specifications is amended to read:

- A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," shall also be furnished for each shipment of epoxy-coated bar reinforcement or wire reinforcement certifying that the coated reinforcement conforms to the requirements in ASTM Designation: A 775/A 775M or A 884/A 884M, respectively, and the provisions in Section 52-1.02B, "Epoxy-coated Reinforcement." The Certificate of Compliance shall include all of the certifications specified in ASTM Designation: A 775/A 775M or A 884/A 884M respectively, and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

Section 52-1.07 "Placing," of the Standard Specifications is amended to read by deleting item C of the third paragraph.

Section 52-1.08 "Splicing," of the Standard Specifications is amended to read:

### 52-1.08 SPLICING

- Splices of reinforcing bars shall consist of lap splices, service splices, or ultimate butt splices.
- Splicing of reinforcing bars will not be permitted at a location designated on the plans as a "No-Splice Zone." At the option of the Contractor, reinforcing bars may be continuous at locations where splices are shown on the plans. The location of splices, except where shown on the plans, shall be determined by the Contractor using available commercial lengths where practicable.
- Unless otherwise shown on the plans, splices in adjacent reinforcing bars at any particular section shall be staggered. The minimum distance between staggered lap splices or mechanical lap splices shall be the same as the length required for a lap splice in the largest bar. The minimum distance between staggered butt splices shall be 600 mm, measured between the midpoints of the splices along a line which is centered between the axes of the adjacent bars.

#### 52-1.08A Lap Splicing Requirements

- Splices made by lapping shall consist of placing reinforcing bars in contact and wiring them together, maintaining the alignment of the bars and the minimum clearances. Should the Contractor elect to use a butt welded or mechanical splice at a location not designated on the plans as requiring a service or ultimate butt splice, this splice shall conform to the testing requirements for service splice.
- Reinforcing bars shall not be spliced by lapping at locations where the concrete section is not sufficient to provide a minimum clear distance of 50 mm between the splice and the nearest adjacent bar. The clearance to the surface of the concrete specified in Section 52-1.07, "Placing," shall not be reduced.
- Reinforcing bars Nos. 43 and 57 shall not be spliced by lapping.
- Where ASTM Designations: A 615/A 615M, Grade 420 or A 706/A 706M reinforcing bars are required, the length of lap splices shall be as follows: Reinforcing bars No. 25 or smaller shall be lapped at least 45 diameters of the smaller bar joined; and reinforcing bars Nos. 29, 32, and 36 shall be lapped at least 60 diameters of the smaller bar joined, except when otherwise shown on the plans.
- Where ASTM Designation: A 615/A 615M, Grade 280 reinforcing bars are permitted, the length of lap splices shall be as follows: Reinforcing bars No. 25 or smaller shall be lapped at least 30 diameters of the smaller bar joined; and reinforcing bars Nos. 29, 32, and 36 shall be lapped at least 45 diameters of the smaller bar joined, except when otherwise shown on the plans.
- Splices in bundled bars shall conform to the following:
  - A In bundles of 2 bars, the length of the lap splice shall be the same as the length of a single bar lap splice.
  - B In bundles of 3 bars, the length of the lap splice shall be 1.2 times the length of a single bar lap splice.

- Welded wire fabric shall be lapped such that the overlap between the outermost cross wires is not less than the larger of:

- A. 150 mm,
- B. The spacing of the cross wires plus 50 mm, or
- C. The numerical value of the longitudinal wire size (MW-Size Number) times 370 divided by the spacing of the longitudinal wires in millimeters.

#### 52-1.08B Service Splicing and Ultimate Butt Splicing Requirements

- Service splices and ultimate butt splices shall be either butt welded or mechanical splices, shall be used at the locations shown on the plans, and shall conform to the requirements of these specifications and the special provisions.

##### 52-1.08B(1) Mechanical Splices

- Mechanical splices to be used in the work shall be on the Department's current prequalified list before use. The prequalified list can be obtained from the Department's internet site listed in the special provisions or by contacting the Transportation Laboratory directly.

- When tested in conformance with the requirements in California Test 670, the total slip of the reinforcing bars within the splice device after loading in tension to 200 MPa and relaxing to 20 MPa shall not exceed the values listed in the following table. The slip shall be measured between gage points that are clear of the splice device.

Reinforcing Bar Number	Total Slip (µm)
13	250
16	250
19	250
22	350
25	350
29	350
32	450
36	450
43	600
57	750

- Slip requirements shall not apply to mechanical lap splices, splices that are welded, or splices that are used on hoops.

- Splicing procedures shall be in conformance with the manufacturer's recommendations, except as modified in this section. Splices shall be made using the manufacturer's standard equipment, jigs, clamps, and other required accessories.

- Splice devices shall have a clear coverage of not less than 40 mm measured from the surface of the concrete to the outside of the splice device. Stirrups, ties, and other reinforcement shall be adjusted or relocated, and additional reinforcement shall be placed, if necessary, to provide the specified clear coverage to reinforcement.

- The Contractor shall furnish the following information for each shipment of splice material in conformance with the provisions in Section 6-1.07, "Certificates of Compliance:"

- A. The type or series identification of the splice material including tracking information for traceability.
- B. The bar grade and size number to be spliced.
- C. A copy of the manufacturer's product literature giving complete data on the splice material and installation procedures.
- D. A statement that the splicing systems and materials used in conformance with the manufacturer's installation procedures will develop the required tensile strengths, based on the nominal bar area, and will conform to the total slip requirements and the other requirements in these specifications.
- E. A statement that the splice material conforms to the type of mechanical splice in the Department's current prequalified list.

#### **52-1.08B(2) Butt Welded Splices**

- Except for resistance butt welds, butt welded splices of reinforcing bars shall be complete joint penetration butt welds conforming to the requirements in AWS D 1.4, and these specifications.
- Welders and welding procedures shall be qualified in conformance with the requirements in AWS D 1.4.
- Only the joint details and dimensions as shown in Figure 3.2, "Direct Butt Joints," of AWS D 1.4, shall be used for making complete joint penetration butt welds of bar reinforcement. Split pipe backing shall not be used.
- Butt welds shall be made with multiple weld passes using a stringer bead without an appreciable weaving motion. The maximum stringer bead width shall be 2.5 times the diameter of the electrode and slagging shall be performed between each weld pass. Weld reinforcement shall not exceed 4 mm in convexity.
- Electrodes used for welding shall meet the minimum Charpy V-notch impact requirement of 27°J at -20°C.
- For welding of bars conforming to the requirements of ASTM Designation: A 615/A 615M, Grade 280 or Grade 420, the requirements of Table 5.2, "Minimum Preheat and Interpass Temperatures," of AWS D 1.4 are superseded by the following:

The minimum preheat and interpass temperatures shall be 200°C for Grade 280 bars and 300°C for Grade 420 bars. Immediately after completing the welding, at least 150 mm of the bar on each side of the splice shall be covered by an insulated wrapping to control the rate of cooling. The insulated wrapping shall remain in place until the bar has cooled below 90°C.

- When welding different grades of reinforcing bars, the electrode shall conform to Grade 280 bar requirements and the preheat shall conform to the Grade 420 bar requirements.
- In the event that any of the specified preheat, interpass, and post weld cooling temperatures are not met, all weld and heat affected zone metal shall be removed and the splice rewelded.
- Welding shall be protected from air currents, drafts, and precipitation to prevent loss of heat or loss of arc shielding. The method of protecting the welding area from loss of heat or loss of arc shielding shall be subject to approval by the Engineer.
- Reinforcing bars shall not be direct butt spliced by thermite welding.
- Procedures to be used in making welded splices in reinforcing bars, and welders employed to make splices in reinforcing bars, shall be qualified by tests performed by the Contractor on sample splices of the type to be used, before making splices to be used in the work.

#### **52-1.08B(3) Resistance Butt Welds**

- Shop produced resistance butt welds shall be produced by a fabricator who is approved by the Transportation Laboratory. The list of approved fabricators can be obtained from the Department's internet site or by contacting the Transportation Laboratory directly.
- Before manufacturing hoops using resistance butt welding, the Contractor shall submit to the Engineer the manufacturer's Quality Control (QC) manual for the fabrication of hoops. As a minimum, the QC manual shall include the following:

- A. The pre-production procedures for the qualification of material and equipment.
- B. The methods and frequencies for performing QC procedures during production.
- C. The calibration procedures and calibration frequency for all equipment.
- D. The welding procedure specification (WPS) for resistance welding.
- E. The method for identifying and tracking lots.

#### **52-1.08C Service Splice and Ultimate Butt Splice Testing Requirements**

- The Contractor shall designate in writing a splicing Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for 1) the quality of all service and ultimate butt splicing including the inspection of materials and workmanship performed by the Contractor and all subcontractors; and 2) submitting, receiving, and approving all correspondence, required submittals, and reports regarding service and ultimate splicing to and from the Engineer.
- The QCM shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors, who will provide other services or materials for the project. The QCM may be an employee of the Contractor.

- Testing on prequalification and production sample splices shall be performed at the Contractor's expense, at an independent qualified testing laboratory. The laboratory shall not be employed or compensated by any subcontractor, or by other persons or entities hired by subcontractors who will provide other services or materials for the project, and shall have the following:

- A. Proper facilities, including a tensile testing machine capable of breaking the largest size of reinforcing bar to be tested with minimum lengths as shown in this section.
- B. A device for measuring the total slip of the reinforcing bars across the splice to the nearest 25  $\mu$ m, that, when placed parallel to the longitudinal axis of the bar is able to simultaneously measure movement across the splice, at 2 locations, 180 degrees apart.
- C. Operators who have received formal training for performing the testing requirements of ASTM Designation: A 370 and California Test 670.
- D. A record of annual calibration of testing equipment performed by an independent third party that has 1) standards that are traceable to the National Institute of Standards and Technology, and 2) a formal reporting procedure, including published test forms.

- The Contractor shall provide samples for quality assurance testing in conformance with the provisions in these specifications and the special provisions.

- Prequalification and production sample splices shall be 1) a minimum length of 1.5 meters for reinforcing bars No. 25 or smaller, and 2 meters for reinforcing bars No. 29 or larger, with the splice located at mid-point; and 2) suitably identified before shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. Splices that shows signs of tampering will be rejected.

- Each set or sample splice, as defined herein, shall be identified as representing either a prequalification or production test sample splice.

- For the purpose of production testing, a lot of either service splices or ultimate butt splices is defined as 1) 150, or fraction thereof, of the same type of mechanical splices used for each bar size and each bar deformation pattern that is used in the work, or 2) 150, or fraction thereof, of complete joint penetration butt welded splices, or resistance butt welded splices for each bar size used in the work. If different diameters of hoop reinforcement are shown on the plans, separate lots shall be used for each different hoop diameter.

- Whenever a lot of splices is rejected, the rejected lot and subsequent lots of splices shall not be used in the work until 1) the QCM performs a complete review of the Contractor's quality control process for these splices, 2) a written report is submitted to the Engineer describing the cause of failure for the splices in this lot and provisions for preventing similar failures in future lots, and 3) the Engineer has provided the Contractor with written notification that the report is acceptable. The Engineer shall have 3 working days after receipt of the report to provide notification to the Contractor. In the event the Engineer fails to provide notification within the time allowed, and if, in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in providing notification, the Contractor will be compensated for any resulting loss, and an extension of time will be granted in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

#### **52-1.08C(1) Splice Prequalification Report**

- Before using any service splices or ultimate butt splices in the work, the Contractor shall submit a Splice Prequalification Report. The report shall include splice material information, names of the operators who will be performing the splicing, and descriptions of the positions, locations, equipment, and procedures that will be used in the work.

- The Splice Prequalification Report shall also include certifications from the fabricator for prequalifications of operators and procedures based on sample tests performed no more than 2 years before submitting the report. Each operator shall be certified by performing 2 sample splices for each bar size of each splice type that the operator will be performing in the work. For deformation-dependent types of splice devices, each operator shall be certified by performing 2 additional samples for each bar size and deformation pattern that will be used in the work.

- Prequalification sample splices shall be tested by an independent qualified testing laboratory and shall conform to the appropriate production test criteria and slip requirements specified herein. When epoxy-coated reinforcement is required, resistance butt welded sample splices shall have the weld flash removed by the same procedure as will be used in the work, before coating and testing. The Splice Prequalification Report shall include the certified test results for all prequalification sample splices.

- The QCM shall review and approve the Splice Prequalification Report before submitting it to the Engineer for approval. The Contractor shall allow 2 weeks for the review and approval of a complete report before performing any service splicing or ultimate butt splicing in the work. In the event the Engineer fails to complete the review within the time allowed, and in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

#### **52-1.08C(2) Service Splice Test Criteria**

- Service production and quality assurance sample splices shall be tensile tested in conformance with the requirements in ASTM Designation: A 370 and California Test 670 and shall develop a minimum tensile strength of not less than 550 MPa.

##### **52-1.08C(2)(a) Production Test Requirements for Service Splices**

- Production tests shall be performed by the Contractor's independent laboratory for all service splices used in the work. A production test shall consist of testing 4 sample splices prepared for each lot of completed splices. The samples shall be prepared by the Contractor using the same splice material, position, operators, location, and equipment, and following the same procedure as used in the work.

- At least one week before testing, the Contractor shall notify the Engineer in writing of the date when and the location where the testing of the samples will be performed.

- The 4 samples from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the independent laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 samples of splices shall not be tested.

- Before performing any tensile tests on production test sample splices, one of the 4 samples shall be tested for, and shall conform to, the requirements for total slip. Should this sample not meet the total slip requirements, one retest, in which the 3 remaining samples are tested for total slip, will be allowed. Should any of the 3 remaining samples not conform to the total slip requirements, all splices in the lot represented by this production test will be rejected.

- If 3 or more sample splices from a production test conform to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," all splices in the lot represented by this production test will be considered acceptable, provided each of the 4 samples develop a minimum tensile strength of not less than 420 MPa.

- Should only 2 sample splices from a production test conform to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," one additional production test shall be performed on the same lot of splices. This additional production test shall consist of testing 4 sample splices that have been randomly selected by the Engineer and removed by the Contractor from the actual completed lot of splices. Should any of the 4 splices from this additional test fail to conform to these provisions, all splices in the lot represented by these production tests will be rejected.

- If only one sample splice from a production test conforms to the provisions in this Section 52-1.08C(2), "Service Splice Test Criteria," all splices in the lot represented by this production test will be rejected.

- If a production test for a lot fails, the Contractor shall repair or replace all reinforcing bars from which sample splices were removed before the Engineer selects additional splices from this lot for further testing.

##### **52-1.08C(2)(b) Quality Assurance Test Requirements for Service Splices**

- For the first production test performed, and for at least one, randomly selected by the Engineer, of every 5 subsequent production tests, or portion thereof, the Contractor shall concurrently prepare 4 additional service quality assurance sample splices. These service quality assurance sample splices shall be prepared in the same manner as specified herein for service production sample splices.

- These 4 additional quality assurance sample splices shall be shipped to the Transportation Laboratory for quality assurance testing. The 4 sample splices shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 samples of splices will not be tested. Sample splices not accompanied by the supporting documentation required in Section 52-1.08B(1), for mechanical splices, or in Section 52-1.08B(3), for resistance butt welds, will not be tested.

- Quality assurance testing will be performed in conformance with the requirements for service production sample splices in Section 52-1.08C(2)(a), "Production Test Requirements for Service Splices."

### **52-1.08C(3) Ultimate Butt Splice Test Criteria**

- Ultimate production and quality assurance sample splices shall be tensile tested in conformance with the requirements described in ASTM Designation: A 370 and California Test 670.
- A minimum of one control bar shall be removed from the same bar as, and adjacent to, all ultimate production, and quality assurance sample splices. Control bars shall be 1) a minimum length of one meter for reinforcing bars No. 25 or smaller and 1.5 meters for reinforcing bars No. 29 or larger, and 2) suitably identified before shipment with weatherproof markings that do not interfere with the Engineer's tamper-proof markings or seals. The portion of adjacent bar remaining in the work shall also be identified with weatherproof markings that correspond to its adjacent control bar.
- Each sample splice and its associated control bar shall be identified and marked as a set. Each set shall be identified as representing a prequalification, production, or quality assurance sample splice.
- The portion of hoop reinforcing bar, removed to obtain a sample splice and control bar, shall be replaced using a prequalified ultimate mechanical butt splice, or the hoop shall be replaced in kind.
- Reinforcing bars, other than hoops, from which sample splices are removed, shall be repaired using ultimate mechanical butt splices conforming to the provisions in Section 52-1.08C(1), "Splice Prequalification Report," or the bars shall be replaced in kind. These bars shall be repaired or replaced such that no splices are located in any "No Splice Zone" shown on the plans.
- Ultimate production and quality assurance sample splices shall rupture in the reinforcing bar either: 1) outside of the affected zone or 2) within the affected zone, provided that the sample splice has achieved at least 95 percent of the ultimate tensile strength of the control bar associated with the sample splice. In addition, necking of the bar shall be visibly evident at rupture regardless of whether the bar breaks inside or outside the affected zone.
- The affected zone is the portion of the reinforcing bar where any properties of the bar, including the physical, metallurgical, or material characteristics, have been altered by fabrication or installation of the splice.
- The ultimate tensile strength shall be determined for all control bars by tensile testing the bars to rupture, regardless of where each sample splice ruptures. If 2 control bars are tested for one sample splice, the bar with the lower ultimate tensile strength shall be considered the control bar.

### **52-1.08C(3)(a) Production Test Requirements for Ultimate Butt Splices**

- Production tests shall be performed for all ultimate butt splices used in the work. A production test shall consist of testing 4 sets of sample splices and control bars removed from each lot of completed splices, except when quality assurance tests are performed.
- After the splices in a lot have been completed, and the bars have been epoxy-coated when required, the QCM shall notify the Engineer in writing that the splices in this lot conform to the specifications and are ready for testing. Except for hoops, sample splices will be selected by the Engineer at the job site. Sample splices for hoops will be selected by the Engineer either at the job site or a fabrication facility.
- After notification has been received, the Engineer will randomly select the 4 sample splices to be removed from the lot and place tamper-proof markings or seals on them. The Contractor shall select the adjacent control bar for each sample splice bar, and the Engineer will place tamper-proof markings or seals on them. These ultimate production sample splices and control bars shall be removed by the Contractor, and tested by an independent qualified testing laboratory.
- At least one week before testing, the Contractor shall notify the Engineer in writing of the date when and the location where the testing of the samples will be performed.
- A sample splice or control bar from any set will be rejected if a tamper-proof marking or seal is disturbed before testing.
- The 4 sets from each production test shall be securely bundled together and identified with a completed sample identification card before shipment to the independent laboratory. The card will be furnished by the Engineer. Bundles of samples containing fewer than 4 sets of splices shall not be tested.
- Before performing any tensile tests on production test sample splices, one of the 4 sample splices shall be tested for, and shall conform to, the requirements for total slip. Should this sample splice not meet these requirements, one retest, in which the 3 remaining sample splices are tested for total slip, will be allowed. Should any of the 3 remaining sample splices not conform to these requirements, all splices in the lot represented by this production test will be rejected.
- If 3 or more sample splices from a production test conform to the provisions in Section 52-1.08C(3), "Ultimate Butt Splice Test Criteria," all splices in the lot represented by this production test will be considered acceptable.

- Should only 2 sample splices from a production test conform to the provisions in Section 52-1.08C(3), "Ultimate Butt Splice Test Criteria," one additional production test shall be performed on the same lot of splices. Should any of the 4 sample splices from this additional test fail to conform to these provisions, all splices in the lot represented by these production tests will be rejected.

- If only one sample splice from a production test conforms to the provisions in Section 52-1.08C(3), "Ultimate Butt Splice Test Criteria," all splices in the lot represented by this production test will be rejected.

- If a production test for a lot fails, the Contractor shall repair or replace all reinforcing bars from which sample splices were removed, complete in place, before the Engineer selects additional splices from this lot for further testing.

- Production tests will not be required on repaired splices from a lot, regardless of the type of prequalified ultimate mechanical butt splice used to make the repair. However, should an additional production test be required, the Engineer may select any repaired splice for the additional production test.

#### **52-1.08C(3)(b) Quality Assurance Test Requirements for Ultimate Butt Splices**

- For the first production test performed, and for at least one, randomly selected by the Engineer, of every 5 subsequent production tests, or portion thereof, the Contractor shall concurrently prepare 4 additional ultimate quality assurance sample splices along with associated control bars.

- Each time 4 additional ultimate quality assurance sample splices are prepared, 2 of these quality assurance sample splice and associated control bar sets and 2 of the production sample splice and associated control bar sets, together, shall conform to the requirements for ultimate production sample splices in Section 52-1.08C(3)(a), "Production Test Requirements for Ultimate Butt Splices."

- The 2 remaining quality assurance sample splice and associated control bar sets, along with the 2 remaining production sample splice and associated control bar sets shall be shipped to the Transportation Laboratory for quality assurance testing. The 4 sets shall be securely bundled together and identified by location and contract number with weatherproof markings before shipment. Bundles containing fewer than 4 sets will not be tested.

- Quality assurance testing will be performed in conformance with the requirements for ultimate production sample splices in Section 52-1.08C(3)(a), "Production Test Requirements for Ultimate Butt Splices."

#### **52-1.08C(3)(c) Nondestructive Splice Tests**

- When the specifications allow for welded sample splices to be taken from other than the completed lot of splices, the Contractor shall meet the following additional requirements.

- Except for resistance butt welded splices, radiographic examinations shall be performed on 25 percent of all complete joint penetration butt welded splices from a production lot. The size of a production lot will be a maximum of 150 splices. The Engineer will select the splices which will compose the production lot and also the splices within each production lot to be radiographically examined.

- All required radiographic examinations of complete joint penetration butt welded splices shall be performed by the Contractor in conformance with the requirements in AWS D 1.4 and these specifications.

- Before radiographic examination, welds shall conform to the requirements in Section 4.4, "Quality of Welds," of AWS D 1.4.

- Should more than 12 percent of the splices which have been radiographically examined in any production lot be defective, an additional 25 percent of the splices, selected by the Engineer from the same production lot, shall be radiographically examined. Should more than 12 percent of the cumulative total of splices tested from the same production lot be defective, all remaining splices in the lot shall be radiographically examined.

- Additional radiographic examinations performed due to the identification of defective splices shall be at the Contractor's expense.

- All defects shall be repaired in conformance with the requirements in AWS D 1.4.

- The Contractor shall notify the Engineer in writing 48 hours before performing any radiographic examinations.

- The radiographic procedure used shall conform to the requirements in AWS D1.1, AWS D1.4, and the following:

Two exposures shall be made for each complete joint penetration butt welded splice. For each of the 2 exposures, the radiation source shall be centered on each bar to be radiographed. The first exposure shall be made with the radiation source placed at zero degrees from the top of the weld and perpendicular to the weld root and identified with a station mark of "0." The second exposure shall be at 90 degrees to the "0" station mark and shall be identified with a station mark of "90." When obstructions prevent a 90 degree placement of the radiation source for the second exposure, and when approved in writing by the Engineer, the source may be rotated, around the centerline of the reinforcing bar, a maximum of 25 degrees.

For field produced complete joint penetration butt welds, no more than one weld shall be radiographed during one exposure. For shop produced complete joint penetration butt welds, if more than one weld is to be radiographed during one exposure, the angle between the root line of each weld and the direction to the radiation source shall be not less than 65 degrees.

Radiographs shall be made by either X-ray or gamma ray. Radiographs made by X-ray or gamma rays shall have densities of not less than 2.3 nor more than 3.5 in the area of interest. A tolerance of 0.05 in density is allowed for densitometer variations. Gamma rays shall be from the iridium 192 isotope and the emitting specimen shall not exceed 4.45 mm in the greatest diagonal dimension.

The radiographic film shall be placed perpendicular to the radiation source at all times; parallel to the root line of the weld unless source placement determines that the film must be turned; and as close to the root of the weld as possible.

The minimum source to film distance shall be maintained so as to ensure that all radiographs maintain a maximum geometric unsharpness of 0.020 at all times, regardless of the size of the reinforcing bars.

Penetrameters shall be placed on the source side of the bar and perpendicular to the radiation source at all times. One penetrometer shall be placed in the center of each bar to be radiographed, perpendicular to the weld root, and adjacent to the weld. Penetrometer images shall not appear in the weld area.

When radiography of more than one weld is being performed per exposure, each exposure shall have a minimum of one penetrometer per bar, or 3 penetrameters per exposure. When 3 penetrameters per exposure are used, one penetrometer shall be placed on each of the 2 outermost bars of the exposure, and the remaining penetrometer shall be placed on a centrally located bar.

An allowable weld buildup of 4 mm may be added to the total material thickness when determining the proper penetrometer selection. No image quality indicator equivalency will be accepted. Wire penetrameters or penetrometer blocks shall not be used.

Penetrameters shall be sufficiently shimmed using a radiographically identical material. Penetrometer image densities shall be a minimum of 2.0 and a maximum of 3.6.

Radiographic film shall be Class 1, regardless of the size of reinforcing bars.

Radiographs shall be free of film artifacts and processing defects, including, but not limited to, streaks, scratches, pressure marks or marks made for the purpose of identifying film or welding indications.

Each splice shall be clearly identified on each radiograph and the radiograph identification and marking system shall be established between the Contractor and the Engineer before radiographic inspection begins. Film shall be identified by lead numbers only; etching, flashing or writing in identifications of any type will not be permitted. Each piece of film identification information shall be legible and shall include, as a minimum, the following information: Contractor's name, date, name of nondestructive testing firm, initials of radiographer, contract number, part number and weld number. The letter "R" and repair number shall be placed directly after the weld number to designate a radiograph of a repaired weld.

Radiographic film shall be developed within a time range of one minute less to one minute more than the film manufacturer's recommended maximum development time. Sight development will not be allowed.

Processing chemistry shall be done with a consistent mixture and quality, and processing rinses and tanks shall be clean to ensure proper results. Records of all developing processes and any chemical changes to the developing processes shall be kept and furnished to the Engineer upon request. The Engineer may request, at any time, that a sheet of unexposed film be processed in the presence of the Engineer to verify processing chemical and rinse quality.

The results of all radiographic interpretations shall be recorded on a signed certification and a copy kept with the film packet.

Technique sheets prepared in conformance with the requirements in ASME Boiler and Pressure Vessels Code, Section V, Article 2 Section T-291 shall also contain the developer temperature, developing time, fixing duration and all rinse times.

#### **52-1.08D Reporting Test Results**

- A Production Test Report for all testing performed on each lot shall be prepared by the independent testing laboratory performing the testing and submitted to the QCM for review and approval. The report shall be signed by an engineer who represents the laboratory and is registered as a Civil Engineer in the State of California. The report shall include, as a minimum, the following information for each test: contract number, bridge number, lot number and location, bar size, type of splice, length of mechanical splice, length of test specimen, physical condition of test sample splice and any associated control bar, any notable defects, total measured slip, ultimate tensile strength of each splice, and for ultimate butt splices, limits of affected zone, location of visible necking area, ultimate tensile strength and 95 percent of this ultimate tensile strength for each control bar, and a comparison between 95 percent of the ultimate tensile strength of each control bar and the ultimate tensile strength of its associated splice.

- The QCM must review, approve, and forward each Production Test Report to the Engineer for review before the splices represented by the report are encased in concrete. The Engineer will have 3 working days to review each Production Test Report and respond in writing after a complete report has been received. Should the Contractor elect to encase any splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase splices pending notification by the Engineer, and in the event the Engineer fails to complete the review and provide notification within the time allowed, and if, in the opinion of the Engineer, the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

- Quality assurance test results for each bundle of 4 sets or 4 samples of splices will be reported in writing to the Contractor within 3 working days after receipt of the bundle by the Transportation Laboratory. In the event that more than one bundle is received on the same day, 2 additional working days shall be allowed for providing test results for each additional bundle received. A test report will be made for each bundle received. Should the Contractor elect to encase splices before receiving notification from the Engineer, it is expressly understood that the Contractor will not be relieved of the responsibility for incorporating material in the work that conforms to the requirements of the plans and specifications. Material not conforming to these requirements will be subject to rejection. Should the Contractor elect to wait to encase splices pending notification by the Engineer, and in the event the Engineer fails to complete the review within the time allowed, and in the opinion of the Engineer, completion of the work is delayed or interfered with by reason of the Engineer's delay in completing the review, the Contractor will be compensated for any resulting loss, and an extension of time will be granted, in the same manner as provided for in Section 8-1.09, "Right of Way Delays."

Section 52-1.08F, "Nondestructive Splice Tests," of the Standard Specifications is amended by deleting the seventh paragraph.

## **2-1.08 DISADVANTAGED BUSINESS ENTERPRISE, SMALL BUSINESS AND DISABLED VETERAN BUSINESS ENTERPRISE UTILIZATION**

### **2-1.08A REPORTING**

Contractors, subcontractors, suppliers and service providers who qualify are requested to apply for certification as a "Small Business" or a "Disabled Veteran Business Enterprise" by submitting an application to the Department of General Services, Office of Small Business and DVBE Certification, 707 3rd Street, West Sacramento, CA 95605 Telephone No. (916) 375-4940 or (800) 559-5529.

Attention is directed to the provisions of the Small Business Procurement and Contract Act, Government Code Section 14835 et seq., and Title 2, California Code of Regulations, Section 1896 et seq. regarding certification as a Small Business, and the provisions of Military and Veterans Code Section 999 et seq. and Title 2, California Code of Regulation, Section 1896.60 et seq. regarding certification as a Disabled Veteran Business Enterprise.

By Executive Orders Nos. D-37-01 and D-43-01 the Governor has declared that the policy of the State is to promote the use and participation of Small Businesses and Disabled Veteran Business Enterprises in the State contracting process. The Executive Orders seek pursuit of an annual 25 percent Small Business participation level, and the statutory 3 percent Disabled Veteran Business Enterprise participation level. Because this project involves Federal funding, the State Small Business preference and the State Disabled Veteran Business Enterprise goal do not apply. However, the Department desires to encourage the highest possible participation of Small Businesses and Disabled Veteran Business Enterprises to achieve the goals as stated in the Executive Orders.

It is requested that the Contractor provide, on a monthly basis, and within 30 days of contract acceptance, reports summarizing the participation of State certified Small Businesses and Disabled Veteran Business Enterprises used in the performance of this contract. For each report submitted to the Engineer, the Contractor will receive \$2,500. To qualify for payment, it is requested that each report include form CEM 2402S-SFOBB. The amount paid for submitting each report shall include full compensation for doing all the work involved in preparing and submitting the report, including accounting, tracking, maintaining, and reporting certified Small Business and Disabled Veteran Business Enterprise use.

It is also requested that the Contractor provide, on a monthly basis reports summarizing the participation of Disadvantaged Business Enterprises used in the performance of this contract. For each report submitted to the Engineer, the Contractor will receive \$2,500. To qualify for payment, it is requested that each report include form CEM 2402F-SFOBB. The amount paid for submitting each report shall include full compensation for doing all the work involved in preparing and submitting the report, including accounting, tracking, maintaining, and reporting Disadvantaged Business Enterprise use. This payment does not apply to the final DBE summary report specified elsewhere in the special provisions.

### **2-1.08B MEETINGS**

In addition to the requirements of these special provisions, it is requested that the Contractor designate an officer responsible for monitoring activities related to DBEs, Small Business, and DVBEs.

The Contractor's officer shall present a report at a quarterly meeting to be conducted at the locations, dates and times designated by the Engineer. The meeting will be hosted by the Department and conducted with officers from the other SFOBB East Span Replacement project contractors and representatives of the community.

The format of the report shall include a status of the project work, a summary of the reported participation of DBEs, Small Business, and DVBEs as shown on the monthly reports since the last quarterly meeting report, and a summary of the anticipated participation in the upcoming project work.

For each quarterly meeting that the officer attends and presents the quarterly report, the Contractor will receive \$5,000. The amount paid for attending and presenting the reports shall include all markups, full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved in preparing and presenting the reports, including copies of the reports, as specified in these special provisions and as directed by the Engineer.

## **5-1.077 PREFERENCE FOR U.S.-FLAG AIR CARRIERS**

(a) Definitions. As used in this clause--

International air transportation means transportation by air between a place in the United States and a place outside the United States or between two places, both of which are outside the United States.

United States means the 50 States, the District of Columbia, and outlying areas.

U.S.-flag air carrier means an air carrier holding a certificate under 49 U.S.C. Chapter 411.

(b) Section 5 of the International Air Transportation Fair Competitive Practices Act of 1974 (49 U.S.C. 40118) (Fly America Act) requires that all Federal agencies and Government contractors and subcontractors use U.S.-flag air carriers for U.S. Government-financed international air transportation of personnel (and their personal effects) or property, to the extent that service by those carriers is available. It requires the Comptroller General of the United States, in the absence of satisfactory proof of the necessity for foreign-flag air transportation, to disallow expenditures from funds, appropriated or otherwise established for the account of the United States, for international air transportation secured aboard a foreign-flag air carrier if a U.S.-flag air carrier is available to provide such services.

(c) If available, the Contractor, in performing work under this contract, shall use U.S.-flag carriers for international air transportation of personnel (and their personal effects) or property.

(d) In the event that the Contractor selects a carrier other than a U.S.-flag air carrier for international air transportation, the Contractor shall include a statement on vouchers involving such transportation essentially as follows:

### **STATEMENT OF UNAVAILABILITY OF U.S.-FLAG AIR CARRIERS**

International air transportation of persons (and their personal effects) or property by U.S.-flag air carrier was not available or it was necessary to use foreign-flag air carrier service for the following reasons (see section 47.403 of the Federal Acquisition Regulation): [State reasons]:

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(End of statement)

(e) The Contractor shall maintain records of all air transportation, including the vouchers itemized in paragraph (d) until the Engineer accepts the contract. These records shall be made available for inspection by interested parties upon request.

(f) The Contractor shall include the substance of this clause, including this paragraph (f), in each subcontract or purchase under this contract that may involve international air transportation.

### **5-1.16 INTEGRATED SHOP DRAWINGS**

Attention is directed to "Working Drawings" elsewhere in these special provisions.

Difficult construction is anticipated at the Pier W2 cap beam and Pier E2 cross beam that are highly congested with reinforcing steel, high strength rods, post-tensioning strand tendons, cable tie-down pipe sleeves, anchor bolts, and other concrete embedded items as shown on the plans. The Contractor shall develop three-dimensional integrated shop drawings (ISD's) for the Pier W2 cap beam and Pier E2 cross beam in accordance with the details shown on the plans and the requirements of this section. ISD's shall be of sufficient detail to demonstrate compatibility of items within the concrete.

Prior to commencing work on the ISD, the Contractor (including any subconsultants hired to work on the ISD) shall attend a meeting with the Engineer to discuss the ISD work.

The Contractor shall utilize commercially available software that checks for interference in three dimensions. Prior to acquiring the software, the Contractor shall submit to the Engineer the product name and application features of the software for review and approval. The software shall be compatible with the computer-aided drafting (CAD) software used to develop the ISD. Bar reinforcement shall be shown with deformed diameters. The Contractor shall develop CAD files using different layers for each type of embedded item such that the sequence of construction of the member or area being detailed can be shown.

Attention is directed to "Working Drawing Campus" elsewhere in these special provisions for other equipment and software requirements.

Embedded items that are to be shown on the ISD's shall include, but are not limited to, the following:

- A. Prestressing ducts, anchorages, and blockouts
- B. Bar reinforcing steel and splices including lap, welded, and mechanical splices
- C. Anchor bolts
- D. Anchor bolt plates
- E. Anchorage reinforcement and hardware
- F. Grout vents
- G. High strength rods
- H. Cable tie-down pipe sleeves
- I. Seismic joint blockout
- J. Drainage pipe
- K. Utility conduits and openings
- L. Inserts, bolt sleeves and studs
- M. Other items, as shown on the plans

The Contractor shall use the ISD to identify and eliminate all interference between the planned positions of embedded items and to satisfy the concrete cover shown on the plans.

If a conflict is identified, the Contractor shall document the conflict and propose changes to the embedded items in the ISD's to resolve the conflict. Proposed changes to the embedded items shall be made by a licensed Engineer practicing Civil Engineering with extensive previous experience developing ISD.

The Contractor's proposed changes in the ISD's shall comply with the following sequence of item adjustments:

- A. Pier W2 Cap Beam:
  - 1. Non structural embedded items
  - 2. Reinforcing steel
  - 3. Vertical prestressing ducts
  - 4. Transverse prestressing ducts
  - 5. Continuity prestressing ducts\*
  - 6. High strength anchor rods\*
  - 7. Cable tie-down cable pipe sleeves\*

\*The Contractor is advised that the Engineer may not permit modifications to the location of items 5, 6, and 7.

B. Pier E2 Cross Beam:

1. Nonstructural embedded items
2. Reinforcing steel
3. Prestressing ducts
4. Shear key anchor bolts\*\*
5. Bearing anchor bolts\*\*

\*\*The Contractor is advised that the Engineer may not permit modifications to the location of items 4 and 5.

If a conflict requires bar reinforcement be adjusted, the Contractor may proceed with performing reinforcing steel adjustments in the ISD's prior to submitting the changes to the Engineer. The Contractor shall consider the following measures in the order prescribed to resolve interference issues during the preparation of the ISD's:

- A. Adjust reinforcement.
- B. Bundle bars.
- C. Relocate splices.
- D. Change reinforcement size and number. Reduction of the total reinforcement area will not be permitted.
- E. Change reinforcement shape.
- F. Move embedded inserts.

The ISD's to be submitted to the Engineer shall include the following:

- A. Three sets of the ISD's corresponding to the details as shown on the plans without any modifications. These ISD's shall indicate all conflicts including locations of the conflicts and items involved in the conflicts.
- B. Two complete lists of conflicts with descriptions and the Contractor's proposed modifications for each conflict. If more than one measure is possible for resolving the conflict, the Contractor shall document each of the alternative measures.
- C. Three sets of the ISD's corresponding to the details as shown on the plans with incorporation of the Contractor's proposed modifications. These ISD's shall indicate that all previous identified conflicts have been resolved and concrete cover requirements as shown on the plans are met.
- D. ISD's shall be 559 mm x 864 mm in size and shall use colored ink to differentiate each type of embedded items. For each portion of the structure, ISD's shall include a minimum of six isometric views. Any two isometric views shall be 90 degrees apart.
- E. Three copies of the ISD's in CAD file format on compact discs or tape for use by the Engineer.

An ISD submittal that complies with all of the above requirements, in the opinion of the Engineer, will be defined as a complete ISD submittal. Submittal of isometric drawings made from ISD's shall in no way relieve the Contractor from any other working drawing submittal required by these special provisions or the Standard Specifications.

CAD files of the contract drawings will not be made available to the Contractor.

After complete ISD's are received by the Engineer, the Contractor shall allow the Engineer 7 days to review the ISD submittal for completeness. If determined to be complete, the Engineer shall have 28 working days from the day of receipt to review and approve the ISD submittal. For proposed modifications that are not approved by the Engineer, the Engineer will propose alternative modifications to the Contractor. The Contractor shall submit revised ISD incorporating the Engineer's alternative modifications as specified in this section. If more than one ISD is submitted at one time, the time to be allowed for the review of the ISD's shall not be less than the review time specified above plus 14 days for each ISD submittal still under review and the Contractor shall designate the sequence in which the submittals are to be reviewed.

Assembly of the mockup represented by the ISD and construction of the Pier W2 Cap Beam and Pier E2 Cross Beam shall not begin until the Engineer has approved the complete ISD submittal with all conflicts resolved.

No extension of time will be permitted for the Contractor's failure to identify all conflicts or to complete the ISD's as required by these special provisions.

Full compensation for preparing ISD's, including all revisions necessary due to conflict resolution measures taken by the Contractor, shall be considered as included in various contract items of work involved and no additional compensation will be allowed therefor.

### 5-1.27 PAYMENTS

Attention is directed to Sections 9-1.06, "Partial Payments," and 9-1.07, "Payment After Acceptance," of the Standard Specifications and these special provisions, and Section 8-4.01, "Audits," of these special provisions.

In conformance with 49 CFR, Part 26, Subpart B, Section 26.29 (b)(1), the retention of proceeds required by Public Contract Code Section 10261 shall not apply. In conformance with Public Contract Code 7200 (b), in subcontracts between the Contractor and a subcontractor and in subcontracts between a subcontractor and any subcontractor thereunder, retention proceeds shall not be withheld, and the exceptions provided in Public Contract Code 7200 (c) shall not apply. At the option of the Contractor, subcontractors shall be required to furnish payment and performance bonds issued by an admitted surety insurer.

The third and fourth paragraphs of Section 9-1.06, "Partial Payments," of the Standard Specifications, and Section 9-1.065, "Payment of Withheld Funds," of the Standard Specifications shall not apply.

The Department shall pay monthly to the Contractor, while carrying on the work, the balance, after deducting therefrom all previous payments and all sums to be kept or withheld under the provisions of the contract. No monthly estimate or payment shall be required to be made when, in the judgement of the Engineer, the work is not proceeding in accordance with the provisions of the contract.

For the purpose of making partial payments pursuant to Section 9-1.06, "Partial Payments," of the Standard Specifications, the amount set forth for the contract items of work hereinafter listed shall be deemed to be the maximum value of the contract item of work which will be recognized for progress payment purposes:

A. Electronic Mobile Daily Diary Computer System Data Delivery	\$20,000
B. Working Drawing Campus	\$5,000,000
C. Accelerated Working Drawings Submittal	\$5,000,000
D. Project Schedule (Critical Path)	\$100,000
E. Establish Marine Access	\$35,000,000

After acceptance of the contract pursuant to the provisions in Section 7-1.17, "Acceptance of Contract," of the Standard Specifications, the amount, if any, payable for a contract item of work in excess of the maximum value for progress payment purposes hereinabove listed for the item, will be included for payment in the first estimate made after acceptance of the contract.

In determining the partial payments to be made to the Contractor, only the following listed materials will be considered for inclusion in the payment as materials furnished but not incorporated in the work:

- A. Prestressing steel in sealed containers
- B. Prestressing ducts and anchorages
- C. Bearings
- D. Seismic Joint
- E. Bar reinforcing steel
- F. Bar reinforcing steel (epoxy coated)
- G. Structural steel
- H. Miscellaneous metal
- I. Steel barrier
- J. Railings
- K. Prefabricated parallel wire strand and wire
- L. Suspender ropes
- M. High Strength Prestressing Rod
- N. S-Wire wrapping

Plate steel for fabrication of structural steel and fabricated elements for structural steel, fabricated and in fenced areas with locked gates or in locked warehouses will be eligible for partial payment if the Contractor furnishes evidence satisfactory to the Engineer that its storage is subject to or under the control of the Department and that it has been designated or fabricated specifically for this project and is of such character that it is not adaptable to any other use.

For the purpose of making partial payments for materials furnished but not incorporated in the work pursuant to these special provisions and Section 9-1.06, "Partial Payments," of the Standard Specifications, the total amount of 25% of the executed contract price for each monthly pay estimate shall be deemed to be the maximum value which will be recognized for progress payment purposes.

To be eligible for these payments, the Contractor shall furnish a bond or first demand bank guarantee to secure the value of potential partial payments for material furnished but not incorporated in the work pursuant to these special provisions and Section 9-1.06, "Partial Payments," of the Standard Specifications. The bond or first demand bank guarantee shall be in a sum equal to at least 25% of the executed contract price, and shall, at a minimum, match the terms of the sample advance payment bond or first demand bank guarantee forms identified in "Project Information" elsewhere in these special provisions. The Contractor shall certify in writing to the Engineer that the proposed bonding company or bank complies with these special provisions. The bonding company shall be licensed to do business in the State of California, and shall be certified to write a bond equal to 30% of the executed contract price by the United States Department of the Treasury. The bank shall have United States operations with a minimum rating of "A-" by either AM Best or Standard & Poor. All alterations, extensions of time, extra and additional work, and other changes authorized by these special provisions or any part of the contract may be made without securing the consent of the surety of the bond or the bank.

### **5-1.39 INSURANCE**

The first sentence of subparagraph F in Section 7-1.165, "Damage by Storm, Flood, Tsunami or Earthquake," of the Standard Specifications, is revised as follows for this contract only:

"Payment for Repair Work -- When the Occurrence that caused the damage was a tsunami, the State will pay the cost of repair determined as provided in Subsection E, that exceeds 5 percent of the amount of the Contractor's bid for bid comparison purposes. When the Occurrence that caused the damage was an earthquake, the State will pay the cost of repair determined as provided in Subsection E, that exceeds the lesser of \$20 million or 5 percent of the amount of the Contractor's bid for bid comparison purposes."

The first sentence of Section 7-1.12B(1)(c), "Liability Limits/Additional Insureds," Subsection (d) of the Standard Specifications, is revised as follows for this contract only:

"\$50,000,000 umbrella or excess liability. Umbrella or excess liability policy shall include products liability completed operations. Further, the umbrella or excess liability coverage shall contain a clause stating that it takes effect (drops down) in the event the primary limits are impaired or exhausted."

The Contractor shall also provide insurance coverage under the Federal Longshoremen's and Harbor Workers Compensation Act, the Jones Act and the Marine Act with respect to work performed from, or by use of, vehicles on any navigable water of the United States, including liability insurance for watercraft operations. The insurance coverage shall contain a combined single limit of at least \$50,000,000 per occurrence and \$50,000,000 aggregate. At the option of the Contractor, liability insurance for watercraft operations may be covered under a separate Protection and Indemnity policy.

#### **10-1.14 WORKING DRAWING CAMPUS**

Attention is directed to requirements of Section 5-1.20, "Areas for Contractor's Use," subsection "Port of Oakland Pier 7.

The objective of the working drawing campus is to prepare, submit, review and process working drawings in the shortest and most efficient manner possible. After the bid, the Department will make its Design engineers available for consultation on site with the contractor's engineers and detailers who are preparing working drawings. The effort will focus on the most critical and time dependent working drawings first to prevent delay to the project schedule. It is the Contractor's responsibility to submit working drawings sufficiently in advance of the start of the affected work, in accordance with "Working Drawings" of these special provisions.

The Contractor shall provide the following within 60 days of contract award to facilitate early resolution of construction working drawings:

1. Suitable office facility located within area described on plot map titled "Pier 7 – Area for Contractor's Use". The facilities shall include workspace for the Contractor's staff as determined by the Contractor plus a minimum of 8 vacant, separate office cubicles or rooms intended for the use by the Department or its representatives, and a common meeting room with meeting table to seat a minimum of 10 people. The facilities shall also include access to a copier, and a fax machine. Each workspace shall include a minimum of a desk, office chair, bookshelf, phone, and T1 computer cabling. The Contractor is responsible for providing local phone service, internet access and building utility services.
2. On-site Coordination Engineer. The Coordination Engineer shall be a full time, on-site, registered Civil Engineer in the State of California, and available to coordinate, manage, and process shop/working drawings for the project.
3. Full time, on-site staff authorized by the Contractor to be capable of producing and revising working drawings, and in conjunction with such work generating and assisting in resolution of requests for information and potentially resultant change orders. It is not required that all the Contractor's design staff be located on-site.
4. Regularly scheduled submittal status meetings (daily if required) to discuss the status and resolve shop/working drawing issues, attended by representatives of the Engineer and the Contractor's coordinator and staff as appropriate.
5. Regular updates of the working drawing submittal schedule specified in "Working Drawing Submittal Schedule," of these special provisions.

If the Contractor elects to centralize their field office to the designated area on Pier 7, the Working Drawing Campus facility may be co-located within the same facility provided that the Department or its representatives have access to the Working Drawing Campus portion of the office at all times.

The Contractor shall provide a submittal for the Working Drawing Campus within the first 30 calendar days of award of contract. The submittal shall show the location of the office, layout of the office space and meeting room, and list of the furnishing, including office computer, telephone, desk and chairs to be supplied. The Department will review within 5 working days.

Conformance with these special provisions does not relieve the Contractor of the responsibility for furnishing complete shop/working drawings or producing finished work of the quality specified in the Standard Specifications, these special provisions and as shown on the plans.

The Contractor shall submit, for approval by the Engineer, a schedule of costs detailing the breakdown of the contract lump sum item. The schedule of costs shall be proportionate to the work involved and shall detail the costs and payment schedule for each cost item associated with the process entailed in obtaining approval on all approved working drawing as specified hereunder. When requested by the Engineer, the Contractor shall furnish any cost data, which might assist the Engineer in verifying one-time partial payments and establishing a suitable schedule of costs. The schedule of costs will be used to determine progress payments for " Working Drawing Campus" during the progress of the work. The schedule of costs shall be submitted to the Engineer for approval within 10 days of contract award. The Engineer shall be allowed 10 days for approval or return for correction of the submittal.

## **EQUIPMENT AND SOFTWARE**

Attention is directed to "Integrated Shop Drawings" elsewhere in these special provisions.

The Contractor shall provide for the State's exclusive possession and use, one complete computer system specifically capable of creating, storing, and updating Integrated Shop Drawings utilizing the latest hardware technology. The software shall be identical to that used by the Contractor in generating the ISD. Before delivery and setup of the computer system, the Contractor shall submit to the Engineer for approval a detailed list of all computer hardware and software the Contractor proposes to furnish. The minimum computer system to be furnished shall include the following:

- A. Complete computer system, including keyboard, mouse with scroll, video card with one hundred twenty eight (128) megabyte on board memory and dual ports, two 530-mm color SVGA monitors (1,024 x 78 pixels, current Pentium IV microprocessor chip, or equivalent or later;
- B. Computer operating system software, compatible with the selected processing unit and CAD software, for Windows 2000, equivalent;
- C. Minimum one (1) gigabytes of random access memory (RAM);
- D. A 100 gigabyte minimum hard disk drive, a 1.44 megabyte 90-mm floppy disk drive, 32x speed minimum CD-RW drive, 10/100 Ethernet card, two UBCUSB ports;
- E. CAD and other software identical to those used by the Contractor to check for conflicts and generate ISD's
- F. Microsoft Office software, the latest version for Windows NT/Windows 2000, or later, and McAfee Virus software or equivalent;
- G. A color laser -jet printer with a minimum of eight (8) megabytes of RAM, capable of 600 dots per inch in color, 600 dots per inch in monochrome or equivalent. Capable of printing fully legible plots in color with a minimum size of 279-mm by 432-mm. LaserJet toner and paper to be provided throughout the contract. HP LaserJet 5500 or later

The computer hardware and software furnished shall be compatible with that used by the Contractor for the production of the ISD, and shall include original instruction manuals and other documentation normally provided with the software.

The Contractor shall furnish, install, set up, maintain and repair the computer hardware and software ready for use at the Working Drawing Campus. The hardware and software shall be installed and ready for use at least 30 days prior to submittal of the first ISD. The Contractor shall provide 16 hours of formal training for the Engineer, and three other agents of the Department designated by the Engineer, in the use of the hardware and software to include generating 3-D drawings, merging files, checking for conflicts in three dimensions and manipulating drawing elements. An authorized vendor of the software products shall perform the training.

All computer hardware and software furnished shall remain the property of the Contractor and shall be removed by the Contractor upon acceptance of the contract.

## **MEASUREMENT AND PAYMENT**

Attention is directed to "Payments," of these special provisions.

The contract lump sum price paid for working drawing campus shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in facilitating early resolution of construction working drawings, including but not limited to utility connection costs, maintenance costs, purchasing of office equipment and furniture, and set up and removal of the office facility.

### 10-1.38 HIGH STRENGTH PRESTRESSING ROD (75 MM)

#### GENERAL

High strength prestressing rods in the W2 cap beam consisting of 75 mm steel rods with anchorages that are grouted in steel ducts shall conform to the details shown on the plans, the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications, and the requirements of these special provisions. Splices in high strength prestressing rods will not be permitted.

Whenever the term "rod" or "rods" appear on the plans or in these special provisions, it shall mean bars conforming to the requirements of British Standard 4486, "Hot Rolled and Hot Rolled and Processed High Tensile Alloy Steel Bars for the Prestressing of Concrete," as follows:

- A. Section 1 to 6 – Applicable
- B. Section 7 – Replace this section with the following:
  - 1. The nominal tensile strength = 1030 N/mm<sup>2</sup>
  - 2. The nominal 0.1% proof load = 835 N/mm<sup>2</sup>
  - 3. The minimum elongation at fracture = 6%
- C. Section 8 - Not applicable
- D. Section 9 - Superseded by the requirements of this section

Whenever "member" is referred to in Section 50, "Prestressing Concrete," of the Standard Specifications it shall be considered to mean high strength prestressing rod.

#### HIGH STRENGTH PRESTRESSING ROD MANUFACTURER

High strength prestressing rods (75 mm) shall be manufactured and supplied by:

MACALLOY LIMITED  
HAWKE STREET, SHEFFIELD, S9 2LN  
UNITED KINGDOM

TEL: +44 (0) 114 242 6704  
FAX: +44 (0) 114 243 1324

Macalloy MFT75 rods and anchorages are the only large diameter high strength prestressing rods known to the State meeting the requirements of this contract. Preliminary testing results and technical data for 75 mm Macalloy MFT75 rods and anchorages have been submitted, reviewed, and determined to be satisfactory by the Engineer.

Macalloy Limited has agreed to furnish 75 mm high strength prestressing MFT75 rods and other services described in these special provisions at the guaranteed price in United States dollars as shown in the following table:

No. of Rod Assemblies	Guaranteed Unit Price	Guaranteed Price
304	\$780	\$237,120

The guaranteed price is valid for a United Kingdom Pounds (GBP) to United States Dollars (USD) exchange rate of 1 GBP = \$1.72 USD +/- 5 percent at the time of order. For exchange rates outside of these limits, the guaranteed price will be based on the actual exchange rate at the time the order is placed.

The guaranteed price includes the following:

- A. Working drawings and supplements.
- B. Quality control for the manufacture of both the final products and test specimens.
- C. Manufacture of 75 mm high strength prestressing rods and anchorages.
- D. Proof testing of high strength prestressing rods and anchorages in accordance with the requirements of "Testing," in this section.
- E. Furnishing rods for sampling and testing, including shipping to the independent laboratory.

The guaranteed price does not include the following:

- A. Delivery to U.K. Port, sea transportation to U.S. Port, installation and stressing of high strength prestressing rods.
- B. Inspection and installation consultation by a qualified representative of the manufacturer at the job-site during installation and stressing of all high strength prestressing rod assemblies.
- C. Steel ducts and grouting of ducts after stressing.
- D. Applicable sales taxes and customs duties.
- E. The cost of transportation and accommodations for manufacturer's personnel.

The manufacturer's charge for stressing the prestressing rods, including all necessary labor and equipment is \$700 per day for weekdays and \$1050 per day for Saturdays and Sundays. The estimated duration of stressing is 12-14 days. The manufacturer's charge for a qualified representative at the job site for inspection and consultation during prestressing rod installation is \$700 per day for weekdays and \$1050 per day for Saturdays and Sundays. These charges apply from day of departure from U.K. to the day of return back to U.K. The FOB location for prestressing rod assemblies is U.K. Port.

The above prices will be guaranteed for orders placed with Macalloy Limited on or before December 31, 2005, provided delivery is accepted between 8 and 20 weeks after the order is placed. The total price will be increased 5 percent for orders placed with Macalloy Limited after December 31, 2005 and on or before December 31, 2006, provided delivery is accepted between 8 and 20 weeks after the order is placed.

Use of the Macalloy high strength prestressing rods is contingent on approval of the contract specific working drawing submittal and successful performance of the Macalloy high strength prestressing rods and anchorages under the testing requirements of this section.

#### **WORKING DRAWINGS**

The Contractor shall submit working drawings and supplement for 75 mm high strength prestressing rods in conformance with the provisions in "Working Drawings" elsewhere in these special provisions.

Working drawings and supplement shall include complete details, information, and drawings of the 75 mm high strength prestressing rods and anchorages and the method, materials, equipment, and procedures for installation and stressing the rod assemblies the Contractor proposes to use. The working drawings shall also include the details, procedures, and schedules of proof testing for 75 mm high strength prestressing rods.

After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 25 working days to review the submittal. No manufacture of the prestressing rods shall begin until complete working drawings and supplement are reviewed and approved, in writing, by the Engineer.

#### **MATERIALS**

The 75 mm high strength prestressing rods shall conform to British Standard 4486, "Hot Rolled and Hot Rolled and Processed High Tensile Alloy Steel Bars for the Prestressing of Concrete," except that rods shall be quenched and tempered instead of cold worked. British Standard 4486 is included in the "Information Handout," available to the Contractor as provided for in Section 2-1.03, "Examination of Plans, Specifications, Contract, and Site of Work," of the Standard Specifications.

Grout shall conform to the provisions in Section 50-1.09, "Bonding and Grouting," of the Standard Specifications.

## **TESTING**

The Contractor shall submit a certificate of compliance in conformance with the requirements in Section 6-1.07 "Certificates of Compliance," of the Standard Specifications for high strength prestressing rod assemblies.

All rods shall be marked and traceable to a specific cast and heat treatment batch. For each heat treatment batch a machined tensile coupon test shall be performed by the Contractor to verify the ultimate strength of the rods. Should a machined tensile coupon test fail to achieve the minimum ultimate tensile stress, that heat treatment batch will be rejected.

The Contractor shall perform full section tensile and anchorage tests on production rods and anchorages in accordance with the requirements of this section. Upon completion of all production rods and anchorages, the Contractor shall notify the Engineer that the rods and anchorages are ready for sampling. The notification shall include results of the machined tensile coupon tests representing each heat treatment batch. The Contractor shall allow the Engineer 35 calendar days to sample, witness testing, and tag the rods and anchorages before shipping. The Engineer shall choose 10 production rods, 5 to be full section tensile tested and 5 to be full section anchorage tested, at an independent laboratory. Each production rod shall be cut into a 2-meter long sample, re-threaded and re-marked as necessary for the full section tensile and anchorage testing. Full section tensile and anchorage tests shall be completed within 20 calendar days of sampling by the Engineer. Should any full section tensile and anchorage test fail to meet the characteristic breaking load of 4311 kN, the entire heat treatment batch represented by the failed test will be rejected. All documentation and test results from Macalloy, the independent laboratory, and any subcontractor involved in the fabrication of the rods and anchorages shall be submitted to the Engineer at the time of sampling.

## **CONSTRUCTION**

High strength prestressing rods shall be installed and stressed in accordance with the approved working drawings. After stressing, the Contractor shall provide for final inspection of the installed assemblies by the manufacturer. The Contractor shall submit written approval of the manufacturer's final inspection to the Engineer.

Prestressing rods shall be protected prior to completion of all grouting against rust, corrosion, and physical damage in conformance with the provisions in Section 50, "Prestressing Concrete," of the Standard Specifications.

Grout from construction operations shall not be permitted to flow into the bay or any drainage facilities and shall be contained and disposed of in conformance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way," of the Standard Specifications and the requirements in "Non-Storm Water Discharges," of these special provisions.

Grout shall be injected at the low end of the void being filled and shall be expelled at the high end until there is no evidence of entrapped air, water or diluted grout being retained within the void area.

## **ALTERNATIVE HIGH STRENGTH PRESTRESSING RODS**

At the Contractor's option, an alternative high strength prestressing rod assembly may be substituted for the Macalloy high strength prestressing rod provided the following requirements are met:

- A. The quality of the alternative high strength prestressing rod system and its suitability for the intended application are at least equal to the Macalloy rod as specified in these special provisions, in the opinion of the Engineer.
- B. Acceptable working drawings and supplemental calculations are furnished to the Engineer as specified herein.
- C. The Contractor's written request for substitution of the alternative high strength prestressing rod is approved by the Engineer.
- D. Submittal for alternative high strength prestressing rod system shall conform to the following requirements:
  1. Due to the time constraints on this contract, only one alternative high strength prestressing rod request for substitution will be considered for review.
  2. The acceptability, quality, and suitability of the alternative high strength prestressing rod system will be made in accordance with the provisions of Section 6-1.05, "Trade Names and Alternatives," of the Standard Specifications.

3. The complete written request for substitution shall include a description of the alternative high strength prestressing rod system; the name of the high strength prestressing rod manufacturer; verification that the qualifications specified herein have been met by the manufacturer for the alternative high strength prestressing rod system; written evidence that alternative high strength prestressing rod system conforms to all requirements specified in these special provisions, and a copy of the manufacturer's list of materials and standards used to manufacture the alternative high strength prestressing rod.
4. The Contractor shall provide to the Engineer, written documentation of the alternative manufacturer's experience in fabricating and supplying high strength prestressing rods and anchorages. This certification shall include the location of each bridge or structure, installation date, governmental agency or owner, and the name, address, and telephone number of each owner's or agency's representative.
5. Alternative high strength prestressing rods shall meet the size and strength requirements as shown on the plans.

Standard data and catalog cut sheets from the alternative high strength prestressing rod manufacturer will not be considered sufficient. The Engineer will not be responsible for seeking further data from the manufacturer, or for otherwise researching the alternative high strength prestressing rod. Failure to provide complete data will be cause for rejection of the alternative high strength prestressing rod.

Development of the Contractor's written request for substitution of the alternative high strength prestressing rod, preparation and submittal of complete working drawings and supplemental information, and testing will be at the Contractor's expense. No compensation nor extension of contract time will be allowed for the development and review processes to evaluate the proposed substitution of an alternative high strength prestressing rod.

The Contractor shall be responsible for any additional costs and time delays associated with selection of the alternative high strength prestressing rod incurred as a result of noncompliance with these requirements, including the failure of the manufacturer to retest revised details or material substitutions of previously prequalified systems.

No alternative high strength prestressing rod shall be manufactured until the Engineer has reviewed and approved, in writing, the working drawings, the results of the proof testing, and the inspection of the system to be used.

#### **MEASUREMENT AND PAYMENT**

High strength prestressing rod (75 mm) will be measured and paid for on a lump sum basis.

The contract lump sum price paid for high strength prestressing rod (75 mm) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the high strength prestressing rod (75 mm) including testing and grouting, complete in place, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for modifications to bridge members or elements made necessary by the use of an alternative high strength prestressing rod system shall be considered as included in the contract lump sum price paid for high strength prestressing rod (75 mm) and no additional compensation will be allowed therefor.

#### **10-1.41 SPHERICAL BUSHING BEARING (PIER E2)**

This work shall consist of fabricating and installing the spherical bushing bearing on Pier E2 in conformance with details shown on the plans and the requirements of these special provisions.

The spherical bushing bearing consists of spherical bushing assembly, bearing top housing, bearing bottom housing, bearing hold down assembly, retaining ring plates, solid shaft, dust cover, base plate, bearing plate, anchor bolts, and assembly bolts. The lubricant shall be self-lubricated and shall be provided for all bronze surfaces and other surfaces as shown on the plans. Bearings shall be anchored in place with high strength non-shrink grout.

Spherical bushing bearings shall be furnished and installed at Pier E2.

#### **GENERAL**

The Contractor's attention is directed to "Steel Structures," of these special provisions for steel casting requirements.

The Contractor's attention is directed to "Shear Key (Pier E2)," of these special provisions for additional installation requirements.

The Contractor's attention is directed "Lubricant and Test," of these special provisions.

The design loads, design rotations, design displacements, and alignment tolerances shall conform to the values as shown on the plans.

#### **WORKING DRAWINGS**

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," elsewhere in these special provisions and these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the spherical bushing bearing and its components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use including the placement of high strength non-shrink grout.

Working drawing submittals shall include the following:

- A. Bearing fabrication plans for all bearings including complete details for each component.
- B. All ASTM, AASHTO, or other material designations including dust cover and its connection to other bearing components, and retaining ring plates.
- C. The bushing wall thickness, fits, and tolerances.
- D. Storage and shipping plans including details of handling and supporting of the bearings. Each bearing shipment shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
- E. Installation plans including the following:
  - 1. Method, materials, equipment, sequence, detailed procedures, and temporary support details that the Contractor proposes to use for installation of the spherical bushing bearing. The Contractor's proposed spherical bushing bearing installation including the solid shaft force fit shall not damage the lubricant at any given time during the installation. The Contractor's proposed spherical bushing bearing installation procedures and sequences shall be detailed in the superstructure construction sequences as specified elsewhere in these special provisions.
  - 2. The Contractor's calculated relative distances for a) relative distance between the centerline of E2 floor beam at box girder (normal to vertical profile) and the centerline of Pier E2 (vertical); distance is measured in the longitudinal direction along the top horizontal surface of concrete crossbeam, and b) relative distance between centerline of longitudinal shear plates (normal to cross slope) and centerline of Pier E2 (vertical); distance is measured in the transverse direction along the top sloped surface of the concrete crossbeam.
- F. Details of lifting locations and mechanisms.

A supplement to the working drawings shall include the following:

- A. The quality control plan (QCP). The QCP of the spherical bushing bearings shall conform to the requirements in "Quality Control" of these special provisions and shall include descriptions, details, and procedures for the fabrication and installation of the spherical bushing bearings, except that the portion of the QCP for welding shall be submitted separately in conformance with "Welding" elsewhere in these special provisions.
- B. The manufacturer of the spherical bushing bearing shall submit to the Engineer a manual for the bearing inspection, maintenance, and replacement. This manual shall include:
  1. A record of spherical bushing bearing for each component including the tracing of all components during the fabrication and installation of spherical bushing bearing.
  2. Recommended life expectancy for each bearing component.
  3. Recommended frequency for bearing inspection and maintenance schedule.
  4. Procedures and details to perform the bearing inspection and maintenance.
  5. List of indication of bearing defects and the associated repair methods, if applicable.
  6. Procedures and sequences for bearing replacement including locations of temporary support, estimate of jacking load for each temporary support location, sequences and methods of detensioning anchor bolts, method of debonding between concrete and base plates and anchor bolts, method of removing and replacing bearings, a list of equipment to be used for bearing replacement, and traffic, safety, and environmental impact.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the United States of America. This registered Civil Engineer or Mechanical Engineer shall be a full-time employee of the spherical bushing bearing manufacturer.

Complete working drawings and supplement shall be submitted to the Engineer within 80 working days after the contract is awarded. After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal.

Upon completion of installation, the Contractor shall submit to the Engineer certification stating that each spherical bushing bearing has been installed in accordance with the approved working drawings and supplements installation procedure.

## **MATERIALS**

The materials specifications of spherical bushing bearing components shall conform to the following table:

Component	ASTM Specifications
Anchor Bolts	A354, Grade BD
Assembly Bolts	A240, Type 316
Bearing Plate	B22-C86300
Spherical Housing	A744, Grade CF-8M
Spherical Ball	B271-C86300
Solid Shaft	Structural Casting, Grade 550
Bearing Bottom Housing	Structural Casting, Grade 550
Bearing Top Housing	Structural Casting, Grade 345
Bearing Hold Down Assembly	Structural Casting, Grade 345

Attention is directed to "Welding" and "Audits" in these special provisions.

Attention is directed to "Lubricant and Test" of these special provisions.

Prestressing operation of anchor bolts shall conform to the requirements in "Prestressing Concrete," elsewhere in these special provisions.

High strength nonshrink grout shall conform to the requirements in "High Strength Nonshrink Grout," elsewhere in these special provisions.

Steel components including plates and anchor bolts shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Clean and paint spherical bushing bearing shall conform to the requirements in "Clean and Paint Structural Steel (Seismic Joint, Spherical Bushing Bearing, and Shear Key)," of these special provisions.

The bronze alloy for the spherical ball and ring bushing shall be high strength manganese bronze centrifugally cast conforming to the requirements of ASTM Designation: B271-C86300. The stainless steel for the spherical housing shall be centrifugally cast conforming to the requirements of ASTM Designation: A744 Grade CF-8F. All items integral to and for the assembly of the bearing shall be stainless steel conforming to ASTM Designation: A 240, Type 304 or Type 316.

The bushing wall thickness, fits, and tolerances shall be as recommended by the manufacturer and specified in the working drawings and supplement.

### **QUALITY CONTROL**

Quality Control (QC) shall be the responsibility of the Contractor. Quality Control shall be performed by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department. As a minimum, the Contractor shall perform inspection and testing prior to fabrication, during fabrication, and after fabrication as specified herein and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents. Quality Control shall apply to each component of the spherical bushing bearing in addition to the assembly, shipping and installation of the bearing.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all fabrication.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

The Contractor shall provide sufficient number of QC Inspectors to ensure continuous inspection.

The Contractor shall designate in writing a Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of the fabrication, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting and receiving all correspondences, required submittals, and reports to and from the Engineer.

The Contractor shall submit to the Engineer 3 copies of Quality Control Plan (QCP), in conformance with the requirements in "Working Drawings," of these special provisions. As a minimum, each QCP shall include the following:

- A. A manual including equipment, testing procedures, and code of safe practices.
- B. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors.
- C. An organizational chart showing all QC personnel and their assigned QC responsibilities.
- D. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:
  - 1. All visual inspections.
  - 2. Tests.
  - 3. Calibration procedures and calibration frequency for all equipment.
- E. Forms to be used for Certificates of Compliance, monthly production logs, and monthly reports.
- F. Mill certificates and material certificates.
- G. Shipping plan.
- H. Installation plan.

Prior to submitting the QCP, a pre-fabrication meeting between the Engineer, Contractor, and fabricator, any entity performing spherical bushing bearing component fabrication or subcontractor to the Fabricator, shall be held to discuss the requirements for the QCP. The pre-fabrication meeting shall be held in San Francisco Bay Area.

After a complete QCP is submitted, the Contractor shall allow the Engineer 10 working days to review the submittal. An amended QCP or addendum shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved QCP. The Contractor shall allow the Engineer 10 working days to complete the review of the amended QCP or addendum.

After final approval of the QCP, amended QCP, or addendum, the Contractor shall submit 7 copies to the Engineer of each of these approved documents.

It is expressly understood that the Engineer's approval of the Contractor's QCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's approval shall not constitute a waiver of any requirement of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding approval of the QCP.

A monthly production log for fabrication shall be kept by the QCM for each day that fabrication is performed. The monthly report from each QC Inspector shall be included in the log.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each spherical bushing bearing. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and approved working drawings and the provisions of the Standard Specifications and these special provisions.

#### **FABRICATION AND INSTALLATION**

The Contractor's attention is directed to "Steel Structures," of these special provisions for fabrication and installation of spherical bushing bearings at Pier E2. The Contractor shall also conform to the requirements specified herein.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for spherical bushing bearings.

Finish coats will not be required on the bearings.

Each bearing shall be marked for location and orientation in conformance with the approved working drawing and supplement. Bearings shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers at all times until immediately before installation.

After completion of spherical bushing bearing fabrication, the Contractor shall assemble all bearing components, except high strength bearing grout, at the Contractor's bearing manufacturer's facility to demonstrate to the Engineer that all bearing components and parts will be installed properly as shown on the plans, and each spherical bushing bearing is capable of rotating  $\pm 8$  degrees about its solid shaft axis and  $\pm 2$  degrees about each of the other two orthogonal axes. Bearing assembly shall be witnessed by the Engineer. The Contractor shall notify the Engineer 20 working days before bearing assembly begins.

Damaged bearings shall be replaced.

Qualified representatives from manufacturers of spherical bushing assembly, bearing top housing, bearing bottom housing, bearing hold down assembly, and solid shaft shall be present during installation of all spherical bushing bearings.

Prior to bearing installation, the Contractor shall measure the relative longitudinal distances between the centerline of E2 floor beam at box girder and the centerline of Pier E2 and relative transverse distances between the centerline of longitudinal shear plates and the centerline of Pier E2. The distances shall be measured and compared with the calculated values as specified in the approved working drawings and supplement. If the longitudinal difference between the centerline of E2 floor beam at box girder and the centerline of Pier E2 is greater than 20 mm or the transverse difference between the centerline of longitudinal shear plate and the centerline of Pier E2 is greater than 5 mm, the Contractor shall suspend bearing installation process, and submit to the Engineer a mitigation plan for approval. The mitigation plan shall include the necessary measures to be taken to compensate for the difference. After the Contractor submits the mitigation plan, the Contractor shall allow the Engineer 10 working days for review. Bearing installation shall not be resumed until the Engineer has reviewed and approved, in writing, the Contractor's mitigation plan.

The Contractor shall install the force fit solid shaft to the spherical bushing. The lubricated surface and lubricant shall not be damaged as a result of force fit installation.

Spherical bushing bearing base plates shall be temporarily supported during grout operations. Temporary supports shall prevent the rotation or displacement of the bearing during grout operation. Temporary supports shall not inhibit the functioning of the spherical bushing bearing after grout has set. Temporary supports shall not restrict the movement at bridge joints due to temperature changes and shortening from prestressing forces. Materials for temporary supports within the limits for placing concrete shall conform to the requirements for form fasteners.

Prior to grouting, all bearings and shear keys shall be surveyed to ensure center of rotations of all bearings and shear keys are aligned in the same axis.

High strength nonshrink grout placement shall conform to the requirements in "High Strength Nonshrink Grout," elsewhere of these special provisions.

#### **BEARING STORAGE**

Spherical bushing bearings shall be transported to and stored at the bearing storage facility as designated by the Engineer. Said location will be within 25 km of the San Francisco-Oakland Bay Bridge Toll Plaza. The Contractor shall notify the Engineer at least two months prior to delivery of the spherical bushing bearings.

#### **MEASUREMENT AND PAYMENT**

Furnish and install spherical bushing bearing (Pier E2) will be measured and paid for by the unit and the number of bearings for payment will be determined by the actual count in the completed work.

The contract unit price paid for furnish and install spherical bushing bearing (Pier E2) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the bearing, temporary supports, installing in final position, including bearing high strength nonshrink grout, and cleaning and painting of spherical bushing bearing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

Full compensation for the qualified representative of the manufacturer of bushing bearing components to be present during installation of all spherical bushing bearings shall be considered as included in the contract unit prices paid for furnish and install spherical bushing bearing (Pier E2) and no additional compensation will be allowed therefor.

If a portion or all of spherical bushing bearings are fabricated at a site more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Payment to the Contractor for furnishing spherical bushing bearings will be reduced \$5,000 for any fabrication site located more than 480 air line kilometers from both Sacramento and Los Angeles, or in the case where a fabrication site is located more than 4800 air line kilometers from both Sacramento and Los Angeles, payment will be reduced \$20,000.

#### **10-1.42 FURNISH SPHERICAL BUSHING RING BEARING (HINGE K)**

This work shall consist of fabricating and assembling the spherical bushing ring bearing for Hinge K in conformance with details shown on the plans and the requirements of these special provisions.

The installation of spherical bushing ring bearings at Hinge K will not be required. The spherical bushing ring bearings of Hinge K shall be stored for future installation as specified in these special provisions.

The spherical bushing ring bearing shall be sliding and rotating type of bearing consisting of segmented anchor rings, anchor studs, spherical housing, anchor bolts, assembly bolts, and spherical bushing ring. Lubricant shall be provided for all bronze surfaces as shown on the plans.

#### **GENERAL**

The Contractor's attention is directed to "Steel Structures," of these special provisions for hinge pipe beam and steel casting requirements.

The Contractor's attention is directed to "Lubricant and Test," of these special provisions.

The design loads, design rotations, and uplift-inside bearing gap shall conform to the values as shown on the plans.

#### **WORKING DRAWINGS**

The Contractor shall submit working drawings in conformance with the provisions in "Working Drawings," elsewhere in these special provisions and these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the spherical bushing ring bearing and its components and the method, materials, equipment, and procedures of fabrication that the Contractor proposes to use.

Working drawing submittals shall include the following:

- A. Bearing fabrication plans for all bearings including complete details for each component.
- B. All ASTM, AASHTO, or other material designations.
- C. Storage and shipping plans including details of handling and supporting of the bearings. Each bearing shipment shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
- D. Assembly plans including methods, materials, equipment, sequence, procedures, and temporary support details that the Contractor proposes to use for assembly of the spherical bushing ring bearing at the Contractor's bearing manufacturer's facility.
- E. Details of lifting locations and mechanisms.

A supplement to the working drawings shall include the following:

- A. The quality control plan (QCP). The QCP of the spherical bushing ring bearings shall conform to the requirements in "Quality Control" of these special provisions and shall include descriptions, details, and procedures for the fabrication of the spherical bushing ring bearings, except that the portion of the QCP for welding shall be submitted separately in conformance with "Welding" elsewhere in these special provisions.
- B. The manufacturer of the spherical bushing ring bearing shall submit to the Engineer a manual for the bearing installation, inspection, maintenance, and replacement. This manual shall include:
  - 1. Method, materials, equipment, sequence, detailed procedures, and temporary support details for installation of the spherical bushing ring bearing. The installation plan shall include the measures to protect lubricant on all lubricative surfaces and stainless steel cladding on the pipe beams from damage during installation.
  - 2. A record of spherical bushing ring bearing for each component including the tracing of all components during the fabrication of spherical bushing ring bearing.
  - 3. Recommended life expectancy for each bearing component.
  - 4. Recommended frequency for bearing inspection and maintenance schedule.
  - 5. Procedures and details to perform the bearing inspection and maintenance.
  - 6. List of indication of bearing defects and the associated repair methods, if applicable.
  - 7. Procedures and sequences for bearing replacement including locations of temporary support and estimate of jacking load for each temporary support location.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the United States of America. This registered Civil Engineer or Mechanical Engineer shall be a full-time employee of the spherical bushing ring bearing manufacturer.

Complete working drawings and supplement shall be submitted to the Engineer within 80 working days after the contract is awarded. After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal.

## **MATERIALS**

The materials specifications of spherical bushing ring bearing components shall conform to the following table:

Component	ASTM Specifications
Segmented Anchor Ring	A709, Grade 50
Anchor Studs	A449, Type 1
Spherical Housing	A747, Stainless Steel
Anchor Bolts	A490
Assembly Bolts	A240, Type 316
Spherical Bushing Ring	B22-C86300

Attention is directed to "Welding" and "Audits" in these special provisions.

Attention is directed to "Lubricant and Test" of these special provisions.

Steel components including segmented anchor rings and anchor bolts shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Clean and paint spherical bushing ring bearing shall conform to the requirements in "Clean and Paint Structural Steel (Seismic Joint, Spherical Bushing Bearing, and Shear Key)," of these special provisions.

## **QUALITY CONTROL**

Quality Control (QC) shall be the responsibility of the Contractor. Quality Control shall be performed by an entity having a line of responsibility distinctly different from that of the manufacturer's fabrication department. As a minimum, the Contractor shall perform inspection and testing prior to fabrication, during fabrication, and after fabrication as specified herein and additionally as necessary to ensure that materials and workmanship conform to the requirements of the contract documents. Quality Control shall apply to each component of the spherical bushing ring bearing in addition to the assembly and shipping of the bearing.

The QC Inspector shall be the duly designated person who acts for and on behalf of the Contractor for inspection, testing, and quality related matters for all fabrication.

Quality Assurance (QA) is the prerogative of the Engineer. The QA Inspector is the duly designated person who acts for and on behalf of the Engineer.

Each QC Inspector shall be responsible for quality control acceptance or rejection of materials and workmanship.

The Contractor shall provide sufficient number of QC Inspectors to ensure continuous inspection.

The Contractor shall designate in writing a Quality Control Manager (QCM). The QCM shall be responsible directly to the Contractor for the quality of the fabrication, including materials and workmanship, performed by the Contractor and subcontractors.

The QCM shall be the sole individual responsible to the Contractor for submitting and receiving all correspondences, required submittals, and reports to and from the Engineer.

The Contractor shall submit to the Engineer 3 copies of Quality Control Plan (QCP), in conformance with the requirements in "Working Drawings," of these special provisions. As a minimum, each QCP shall include the following:

- A. A manual including equipment, testing procedures, and code of safe practices.
- B. The names, qualifications, and documentation of certifications for the QCM and all QC Inspectors.
- C. An organizational chart showing all QC personnel and their assigned QC responsibilities.

- D. The methods and frequencies for performing all required quality control procedures, including QC inspection forms to be used, as required by the specifications including:
  - 1. All visual inspections.
  - 2. Tests.
  - 3. Calibration procedures and calibration frequency for all equipment.
- E. Forms to be used for Certificates of Compliance, monthly production logs, and monthly reports.
- F. Mill certificates and material certificates.
- G. Shipping plan.

Prior to submitting the QCP, a pre-fabrication meeting between the Engineer, Contractor, and fabricator, any entity performing spherical bushing ring bearing component fabrication or subcontractor to the Fabricator, shall be held to discuss the requirements for the QCP. The pre-fabrication meeting shall be held in San Francisco Bay Area.

After a complete QCP is submitted, the Contractor shall allow the Engineer 10 working days to review the submittal. An amended QCP or addendum shall be submitted to, and approved in writing by the Engineer, for proposed revisions to the approved QCP. The Contractor shall allow the Engineer 10 working days to complete the review of the amended QCP or addendum.

After final approval of the QCP, amended QCP, or addendum, the Contractor shall submit 7 copies to the Engineer of each of these approved documents.

It is expressly understood that the Engineer's approval of the Contractor's QCP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's approval shall not constitute a waiver of any requirement of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding approval of the QCP.

A monthly production log for fabrication shall be kept by the QCM for each day that fabrication is performed. The monthly report from each QC Inspector shall be included in the log.

The QCM shall sign and furnish to the Engineer, a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications for each spherical bushing ring bearing. The certificate shall state that all of the materials and workmanship incorporated in the work, and all required tests and inspections of this work have been performed in conformance with the details shown on the plans and approved working drawings and the provisions of the Standard Specifications and these special provisions.

#### **FABRICATION AND ASSEMBLY**

The Contractor's attention is directed to "Steel Structures," of these special provisions for fabrication of spherical bushing ring bearings at Hinge K. The Contractor shall also conform to the requirements specified herein.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for spherical bushing ring bearings.

Finish coats will not be required on the bearings.

Each bearing shall be marked for location and orientation in conformance with the approved working drawing and supplement. Bearings shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers at all times.

After completion of spherical bushing ring bearing fabrication, the Contractor shall assemble all bearing components at the Contractor's bearing manufacturer's facility to demonstrate to the Engineer that all bearing components and parts will be installed properly as shown on the plans. Bearing assembly shall be witnessed by the Engineer. The Contractor shall notify the Engineer 20 working days before bearing assembly begins.

Damaged bearings shall be replaced.

**BEARING STORAGE**

Spherical bushing ring bearings shall be transported to and stored at the bearing storage facility as designated by the Engineer. Said location will be within 25 km of the San Francisco-Oakland Bay Bridge Toll Plaza. The Contractor shall notify the Engineer at least two months prior to delivery of the spherical bushing ring bearings.

**MEASUREMENT AND PAYMENT**

Furnish spherical bushing ring bearing (Hinge K) will be measured and paid for by the unit and the number of bearings for payment will be determined by the actual count of completed bearings in the bearing storage facility as specified in these special provisions.

The contract unit price paid for furnish spherical bushing ring bearing (Hinge K) shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the bearing,, temporary supports, cleaning and painting, assembling at bearing manufacturer's facility, and transporting of spherical bushing ring bearing, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

If a portion or all of spherical bushing ring bearings are fabricated at a site more than 480 air line kilometers from both Sacramento and Los Angeles, additional shop inspection expenses will be sustained by the State. Payment to the Contractor for furnishing spherical bushing ring bearings will be reduced \$5,000 for any fabrication site located more than 480 air line kilometers from both Sacramento and Los Angeles, or in the case where a fabrication site is located more than 4800 air line kilometers from both Sacramento and Los Angeles, payment will be reduced \$20,000.

#### **10-1.43 TOWER CROSS BRACING SPHERICAL BUSHING BEARING**

This work shall consist of fabricating and installing tower cross bracing spherical bushing bearing in conformance with details shown on the plans and the requirements of these special provisions.

##### **GENERAL**

The Contractor's attention is directed to Section "Steel Structures," of these special provisions for steel casting and tower cross bracing installation requirements.

Tower cross bracing spherical bushing bearing shall accommodate the pin diameter, maximum angle of rotation, and maximum dynamic load as shown on the plans.

##### **WORKING DRAWINGS**

The Contractor shall submit working drawings in conformance with the provisions in Section, "Working Drawings," elsewhere in these special provisions and these special provisions.

Working drawings shall include complete details, information, drawings, and substantiating calculations of the tower cross bracing spherical bushing bearing and its components and the method, materials, equipment, and procedures of fabrication and installation that the Contractor proposes to use.

Working drawing submittals shall include the following:

- A. Bearing fabrication plans for all bearings including complete details for each component or bearing models and manufacturer's name and technical specifications. The bearing details shall include the rubber covers to seal the bearings.
- B. All ASTM, AASHTO, or other material designations.
- C. The bushing wall thickness, fits, and tolerances.
- D. Storage and shipping plans including details of handling and supporting of the bearings. Each bearing shipment shall be accompanied by a Certificate of Compliance in conformance with the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval.
- E. Installation plans including method, materials, equipment, sequence, detailed procedures, and temporary support details that the Contractor proposes to use for installation of the tower cross bracing spherical bushing bearing. The Contractor's proposed tower cross bracing spherical bushing bearing installation procedures and sequences shall be detailed in the tower cross bracing installation sequences as specified elsewhere in these special provisions.

A supplement to the working drawings shall include the following:

- A. The manufacturer of the tower cross bracing spherical bushing bearing shall submit to the Engineer the verification that the spherical bushing bearings have been used for 3 similar projects for at least 3 years of each project.
- B. The manufacturer of the tower cross bracing spherical bushing bearing shall submit to the Engineer a manual for the bearing inspection, maintenance, and replacement. This manual shall include:
  - 1. A record of tower cross bracing spherical bushing bearing for each component at each location including the tracing of all components during the fabrication and installation of tower cross bracing spherical bushing bearing.
  - 2. Recommended life expectancy for each bearing component.
  - 3. Recommended frequency for bearing inspection and maintenance schedule.
  - 4. Procedures and details to perform the bearing inspection and maintenance.
  - 5. List of indication of bearing defects and the associated repair methods, if applicable.
  - 6. Procedures and sequences for bearing replacement including locations of temporary support, estimate of jacking load for each temporary support location, direction of loading, method of removing and replacing bearings, a list of equipment to be used for bearing replacement, and traffic, safety, and environmental impact.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the United States of America. This registered Civil Engineer or Mechanical Engineer shall be a full-time employee of the tower cross bracing spherical bushing bearing manufacturer.

Complete working drawings and supplement shall be submitted to the Engineer within 80 working days after the contract is awarded. After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal.

Upon completion of installation, the Contractor shall submit to the Engineer certification stating that each tower cross bracing spherical bushing bearing has been installed in accordance with the approved working drawings and supplements installation procedure.

## **MATERIALS**

Attention is directed to "Welding" and "Steel Audits" in these special provisions.

Steel components including plates shall conform to the details shown on the plans, the provisions in "Steel Structures," of the Standard Specifications, and these special provisions.

Clean and paint tower cross bracing spherical bushing bearing shall conform to the requirements in "Clean and Paint Structural Steel (Seismic Joint, Spherical Bushing Bearing, and Shear Key)," of these special provisions.

The bushing wall thickness, fits, and tolerances shall be as recommended by the manufacturer and specified in the working drawings and supplement.

The retainer ring, boss plate, pin, and spacer pipe shall conform to ASTM Specifications as shown on the plans.

## **FABRICATION AND INSTALLATION**

The Contractor's attention is directed to Section, "Steel Structures," of these special provisions for fabrication and installation of tower cross bracing spherical bushing bearings. The Contractor shall also conform to the requirements specified herein.

The coefficient of friction for bearing lubricant shall be equal or less than 0.10.

Conformance with the requirements in SSPC-QP 1, SSPC-QP 2, and SSPC-QP 3 of the "SSPC: The Society for Protective Coatings" will not be required for tower cross bracing spherical bushing bearings.

Finish coats will not be required on the bearings.

The Contractor shall provide the rubber covers to tower cross bracing spherical bushing bearings to seal the bearings with the details in the approved working drawings and supplement.

Each bearing shall be marked for location and orientation in conformance with the approved working drawing and supplement. Bearings shall be secured to shipping skids in a manner that assures protection during transportation and off-loading. Each skid shall be wrapped in moisture proof and dust proof covers at all times until immediately before installation.

Damaged bearings shall be replaced.

A qualified representative of the manufacturer shall be present during installation of all tower cross bracing spherical bushing bearings.

Full compensation for fabricating and installing tower cross bracing spherical bushing bearing shall be considered as included in the contract prices paid per kilogram for furnish and erect structural steel (bridge) (tower), and no separate payment will be made therefor.

#### **10-1.441 LUBRICANT AND TEST**

This work shall consist of furnishing and testing lubricant for spherical bushing bearing (Pier E2), spherical bushing ring bearing (Hinge K), and shear key (Pier E2) in conformance with details shown on the plans and the requirements of these special provisions.

The Contractor's attention is directed to "Spherical Bushing Bearing (Pier E2)," "Spherical Bushing Ring Bearing (Hinge K)," and "Shear Key (Pier E2)," of these special provisions.

#### **WORKING DRAWINGS**

The Contractor shall submit working drawings in conformance with the provisions in Section, "Working Drawings," elsewhere in these special provisions and these special provisions.

Working drawing submittals shall include the following:

- A. Documentation of the Contractor's proposed lubricant to be used for spherical bushing bearing, spherical bushing ring bearing, and spherical housing for shear key. The lubricant shall have a minimum of 3 years history and shall have been used for a minimum of 3 projects of similar application.
- B. Details, procedures, and schedules of friction tests of the lubricant conforming to "Testing" of this section. The Contractor shall submit written verification that the testing laboratory is available to perform the friction tests within the specified schedules. The friction testing plan shall include design and drawings of test fixtures, and details of the testing apparatus and equipment included in the testing program. The friction testing plan shall also include certifications that all testing equipment have been calibrated no longer than 12 months prior to start of testing.

Each working drawing and calculation sheet shall be signed by an engineer who is registered as a Civil Engineer or Mechanical Engineer in the United States of America.

Complete working drawings and supplement shall be submitted to the Engineer within 80 working days after the contract is awarded. After complete working drawings and supplement are received by the Engineer, the Contractor shall allow the Engineer 40 working days to review the submittal. No fabrication of test specimen and test fixtures shall begin until complete working drawings and supplement are reviewed and approved, in writing, by the Engineer.

Within 10 working days after the tests have been successfully completed, the Contractor shall submit to the Engineer 4 copies of the test records, results, certified test reports, and all other relevant test information for review and approval.

The Contractor shall allow the Engineer 30 working days to review each of the certified test reports for the tests.

#### **MATERIALS**

The lubricant shall consist of a combination of solids having non-deteriorating characteristics as well as inherent lubricating qualities. The lubricant shall be capable of withstanding the effects of long-term atmospheric exposure and submersion in seawater, fresh water, and most solvents. Graphite, molybdenum disulfide or other ingredients that tend to promote electrolytic or chemical action shall not be used in the lubricant. The use of shellac, tars, solvents or other non-lubricating binder materials shall not be permitted. The lubricant shall have a durometer hardness of 90 on the Shore 'A' scale when tested in accordance with ASTM Designation: D2240.

The lubricant shall be integrally molded and compressed into recesses provided for containment of the lubricant. The recesses shall be of sufficient depth to properly contain the lubricant and shall comprise not less than 30 percent of the total bearing area. The recesses shall be arranged in an overlapping geometric pattern with successive rows overlapping in the direction of motion. Trepan recesses, not drilled holes, shall be used for diameters 250 mm and larger.

The lubricant shall cover 100 percent of the sliding bearing area and shall be dense. The lubricant shall not be scraped or machined in any way after manufacture. The surface roughness of the lubricated surface and its mating surface shall not exceed 0.003 mm.

The following manufacturers have stated that they have the lubricant products that meet the requirements of these special provisions:

- A. Cosmec, Inc.  
Lubricant Product Name: XL-10  
Address: P.O. Box 390  
70 South Street  
Walpole, Massachusetts 02081  
Tel: (508) 668-6600  
Fax: (508) 660-1022  
Contact Person: Matt McAndrews
- B. Lubrite Technologies  
Lubricant Product Name: G10  
Address: 145 Webster Street, Suite J  
Hanover, Massachusetts 02339  
Tel: (781) 871-1420  
Fax: (781) 871-1492  
Contact Person: John Gunn/James Moy
- C. Lubron Bearing Systems  
Lubricant Product Name: AQ100  
Address: 17611 Metzler Lane  
Huntington Beach, California 92647  
Tel: (714) 841-3007  
Fax: (714) 841-3507  
Contact Person: Jim James

#### **TESTING**

The Contractor shall perform friction tests on the specimens as shown on the plans at the laboratory designated in the approved working drawings and supplement.

The fabrication of all components of the test specimens including material specifications, fabrication procedures, workmanship, and quality control program shall be the same as that used in the production of spherical bushing bearings or shear keys. Specimens that are subject to tests shall not be installed in the bridge and shall become the property of the State. The Contractor shall transport tested specimens to a location as designated by the Engineer. Said location will be within 25 km of the San Francisco-Oakland Bay Bridge Toll Plaza. The Contractor shall notify the Engineer at least 30 working days prior to delivery of tested specimens to allow the Engineer to inspect tested specimens in the Contractor's testing laboratory. The tested specimens shall not be damaged during transportation.

The Contractor shall notify the Engineer, in writing, at least 20 working days prior to the start of each test.

The Contractor shall provide the necessary access and assistance to the Engineer to observe the tests, monitor the process, and take measurements. The Contractor shall also provide space in the testing facility to accommodate the Engineer's monitoring equipment.

After completion of each test, the Contractor shall inspect the test specimen, in the presence of the Engineer, to identify any damage that may have occurred to the test specimen components.

#### **Test Fixtures**

The test fixture elements including all connection components and details shall be fabricated to match the surface of the tested bearing specimens as shown on the plans and as specified elsewhere in these special provisions. The materials and tolerances of the fixture mating surfaces shall be the same as those specified for the box girders in Section "Steel Structures," of these special provisions.

The test fixture elements shall be subject to the same quality control and inspection requirements as spherical bushing bearings and box girders as specified in Section, "Steel Structures," elsewhere in these special provisions.

### **Friction Tests**

The Contractor shall fabricate the specimens as shown on the plans and as specified herein. The Contractor shall also fabricate the test fixtures for the specimens to perform the friction tests at the loading conditions in the order prescribed in the tables as shown on the plans. For each test, applied bearing pressure to the specimen shall conform to the values in the table as shown on the plans.

The test results shall be certified correct and signed by the testing laboratory personnel who conducted the test and interpreted the results.

After friction tests have been successfully completed, all certified test reports are reviewed, and the final approval is given, in writing by the Engineer, the Contractor may start the fabrication of spherical bushing bearings, spherical bushing ring bearings, and spherical housings for shear keys.

### **Testing Requirements**

Prior to the start of the first test of each specimen all steel sliding surfaces shall be cleaned using alcohol. No greasing or lubricating agents shall be applied to any part of the sliding interfaces.

For each test specimen, the first test shall be completed after conditioning specimens for 12 hours at  $20^{\circ}\pm 8^{\circ}\text{C}$ . All tests shall be conducted at an ambient temperature of  $20^{\circ}\pm 8^{\circ}\text{C}$ .

The Contractor shall record downwards load, shear force for computing the coefficient of friction, and time for every test. Readings shall be taken at sufficiently close intervals to detect the force peak that may occur at the reversal of direction but not less than 200 readings per cycle. The zero for force shall be taken as the mid-point between the forces at zero displacement during sliding in the two different directions. Friction forces shall be measured from this zero value. A record of readings shall be kept for all cycles of all tests.

Test loadings shall be applied at a rate between 10 and 20 MPa per minute and shall be released at a rate not exceeding 20 MPa per minute.

### **Acceptance Criteria**

The friction tests shall be performed to verify the coefficient of friction between the lubricated surface and the mating surface at different bearing pressures. The friction tests shall conform to the following procedures and requirements:

- A. The friction test shall be conducted in such a way that all of the shear movement of the test specimens occurs at the sliding interface.
- B. The test load shall be applied without any relative movement of the sliding surfaces for a minimum of 1 hour prior to the application of relative displacements

The acceptance criteria for friction tests shall be the following:

- A. The coefficient of friction value shall be computed by dividing the force parallel to the sliding surface, which corresponds to sliding or rotating movement by the force normal to the sliding surface.
- B. The coefficient of friction for all tests shall meet the requirements as specified in the tables as shown on the plans.

### **MEASUREMENT AND PAYMENT**

Full compensation for lubricant and testing including test specimens, test fixtures, and transportation of tested specimens to the location as designated by the Engineer shall be considered as included in the various contract items of work involved and no separate payment will be made therefor.

#### **10-1.49 REINFORCEMENT**

Reinforcement shall conform to the provisions in Section 52, "Reinforcement," of the Standard Specifications and these special provisions.

Attention is directed to the section "Headed Bar Reinforcement," of these special provisions.

Exposed portion of reinforcement at the top of columns shall be cleaned and painted. Dirt, loose rust and mill scale shall be removed in conformance with the requirements in Surface Preparation Specification No. 2, "Hand Tool Cleaning," of the "SSPC: The Society for Protective Coatings." One application of a zinc-rich primer shall be applied to the exposed surface of the reinforcement in conformance with the provisions in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications.

The Department's mechanical splices prequalified list can be found at the following internet site:

[http://www.dot.ca.gov/hq/esc/approved\\_products\\_list/](http://www.dot.ca.gov/hq/esc/approved_products_list/)

The provisions of "Welding Quality Control" of these special provisions shall not apply to resistance butt welding.

At the option of the Contractor, sample splices and control bars shall be either 1) removed from the completed lot, or 2) prepared using the same splice material, position, operators, location, equipment, and following the same procedure as used in the work.

#### **EPOXY-COATED PREFABRICATED REINFORCEMENT**

Bar reinforcement to be epoxy-coated shall conform to the ASTM Designation and grade required or permitted by Section 52-1.02A, "Bar Reinforcement," of the Standard Specifications, for the location or type of structure involved. The coated bar reinforcement shall conform to the requirements in ASTM Designation: A 934/A 934M except as provided herein.

Wire reinforcement to be epoxy-coated shall conform to the ASTM Designation and grade required or permitted by Section 52-1.02D, "Reinforcing Wire," of the Standard Specifications, for the location or type of structure involved. The coated wire reinforcement shall conform to the requirements for Class A, Type 2 coating of ASTM Designation: A 884/A 884M except as provided herein. The coated welded wire fabric shall conform to the requirements for Class A, Type 1 coating of ASTM Designation: A 884/A 884M.

Appendices X1 and X2, "Guidelines For Job-Site Practices," of ASTM Designation: A 884/A 884M and A 934/A 934M, respectively, shall apply except as provided herein. The term "shall" shall replace the term "should" in these appendices. Section X1.2 of Appendix X1 and Section X2.2 of Appendix X2 shall not apply.

All coatings shall be purple or gray in color.

Except for field welding of butt splices, all welding of reinforcement shall be complete prior to epoxy coating the reinforcement.

Prior to epoxy coating, all resistance butt welds shall have the weld flash removed to produce a smooth profile free of any sharp edges that would prevent proper coating of the bar. The flash shall be removed such that the ultimate tensile strength and elongation properties of the bar are not reduced, and the outside radius of the flash, at any point along the circumference of the bar, is 1) not less than the nominal radius of the bar, nor 2) greater than 5 mm beyond the nominal radius of the bar.

A proposed weld flash removal process shall be submitted to and approved by the Engineer in writing, prior to performing any removal work. The submittal shall demonstrate that the proposed flash removal process produces a smooth profile that can be successfully epoxy-coated in conformance with the requirements specified herein.

Bending of epoxy-coated reinforcement after the coating has been applied will not be allowed.

When any portion of a reinforcing bar or wire requires epoxy coating, the entire bar or wire shall be coated, except, when the bar or wire is spliced outside of the limits of epoxy coating shown on the plans, epoxy coating will not be required on the portion of bar or wire beyond the splice.

Within areas where epoxy-coated reinforcement is required, tie wire and bar chairs or other metallic devices used to secure or support the reinforcement shall be plastic-coated or epoxy-coated to prevent corrosion of the devices or damage to the coated reinforcement.

Prior to coating, the Contractor shall furnish to the Transportation Laboratory a representative 110 g sample from each batch of epoxy coating material to be used. Each sample shall be packaged in an airtight container identified with the manufacturer's name and batch number.

Two 700-mm long samples of coated bar or wire reinforcement from each size and from each load shipped to the jobsite shall be furnished to the Transportation Laboratory for testing. These samples shall be representative of the material furnished. These samples, as well as any additional random samples taken by the Engineer, may be tested for specification compliance. Additional sampling, and all tests performed by the Engineer, may be performed at any location deemed appropriate by the Engineer. Failure of any sample to meet the requirements of the specifications will be cause for rejection.

If any bar tested for coating thickness or for adhesion of coating fails to meet the requirements for coated bars in Section 9 of ASTM Designation: A 934/A 934M, 2 retests on random samples taken from bars represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated bars represented by the samples may be certified as meeting the test requirements.

If any wire reinforcement tested for coating thickness or for flexibility fails to meet the requirements for coated wire in Section 8 of ASTM Designation: A 884/A 884M, 2 retests on random samples taken from wire represented by the failed test will be conducted for each failed test. If the results of both retests meet the specified requirements, the coated wire represented by the samples may be certified as meeting the test requirements.

Epoxy-coated reinforcement shall be covered with an opaque polyethylene sheeting or other suitable protective material to protect the reinforcement from exposure to sunlight, salt spray, and weather. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be adequately secured; however, it should allow for air circulation around the reinforcement to prevent condensation under the covering. Epoxy-coated reinforcement shall not be stored within 300 m of ocean or tidal water for more than 2 months.

All visible damage to coatings caused by shipping, handling, or installation shall be repaired as required for repairing coating damaged prior to shipment conforming to the requirements in ASTM Designation: A 934/A 934M for bar reinforcement or ASTM Designation: A 884/A 884M for wire reinforcement. When the extent of coating damage prior to repair exceeds 2 percent of the bar or wire surface area in any 300-mm length, repair of the bar or wire will not be allowed, and the coated bar or wire will be rejected.

The patching material and process shall be suitable for field application. The patching material shall be prequalified as required for the coating material and shall be either identified on the container as a material compatible with the reinforcement coating, or shall be accompanied by a Certificate of Compliance certifying that the material is compatible with the reinforcement coating. Damaged areas shall be patched in conformance with the patching material manufacturer's recommendations.

Except for lap splices, all splices for epoxy-coated reinforcement shall be coated with a corrosion protection covering that is on the Department's list of approved products. The covering shall be installed in conformance with the manufacturer's recommendations and as directed by the Engineer. The list is available from the Transportation Laboratory.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications, shall be furnished for each shipment of epoxy-coated bar or wire reinforcement certifying that the coated bars or wire conform to the requirements in ASTM Designation: A 934/A 934M for bars or A 884/A 884M for wire and Section 52-1.02B, "Epoxy-coated Reinforcement," of the Standard Specifications. This Certificate of Compliance shall include all the certifications specified in ASTM Designation: A 934/A 934M for bars or ASTM Designation: A 884/A 884M for wire and a statement that the coating material has been prequalified by acceptance testing performed by the Valley Forge Laboratories, Inc., Devon, Pennsylvania.

Any portion of bar or wire reinforcement extending beyond the limits for epoxy-coated reinforcement shown on the plans will be measured and paid for as bar reinforcing steel (bridge).

#### **MEASUREMENT AND PAYMENT**

Measurement and payment for reinforcement in structures shall conform to the provisions in Section 52-1.10, "Measurement," and Section 52-1.11, "Payment," of the Standard Specifications and these special provisions.

Full compensation for removing corrosion protection from existing reinforcement, as shown on the plans, shall be considered as included in the contract prices paid for the various contract items of work involved and no additional compensation will be allowed therefor.

#### **10-1.62 CLEAN AND PAINT STRUCTURAL STEEL**

Exposed new metal surfaces shall be cleaned and painted in conformance with the provisions in Section 59-2, "Painting Structural Steel," and Section 91, "Paint," of the Standard Specifications and these special provisions. Exposed surfaces include all surfaces exposed to the atmosphere.

Section 59-2.01, "General," of the Standard Specifications is amended by adding the following paragraph after the first paragraph:

- Unless otherwise specified, painting Contractors or subcontractors shall be required to have the following certifications from the "SSPC: The Society for Protective Coatings" (formerly the Steel Structures Painting Council), prior to performing the work:

- A. For cleaning and painting of structural steel in the field, certification in conformance with the requirements in Qualification Procedure No. 1, "Standard Procedure For Evaluating Painting Contractors" (SSPC-QP 1).
- B. For the removal of paint from structural steel, certification in conformance with the requirements in Qualification Procedure No. 2, "Standard Procedure For Evaluating The Qualifications of Painting Contractors To Remove Hazardous Paint" (SSPC-QP 2).
- C. For cleaning and painting of structural steel in a permanent painting facility, certification in conformance with the requirements in Qualification Procedure No. 3, "Standard Procedure For Evaluating Qualifications of Shop Painting Contractors" (SSPC-QP 3). The AISC's Sophisticated Paint Endorsement (SPE) quality program will be considered equivalent to SSPC-QP 3.

Whenever the Standard Specifications refer to "Steel Structures Painting Council," the reference shall be replaced with "SSPC: The Society for Protective Coatings."

Attention is directed to "Metallizing" of these special provisions for surface coating the inside of saddle troughs.

The Contractor shall provide suitable enclosures to permit cleaning and painting during inclement weather. Provisions shall be made to control atmospheric conditions inside the enclosures within limits suitable for cleaning throughout the cleaning operation, painting throughout the painting operation, drying throughout the drying period to solvent insolubility, and throughout the curing period per the manufacturers' recommendations and these special provisions. Full compensation for providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work requiring paint and no additional compensation will be allowed therefor.

No extension of contract time will be granted and no additional compensation will be allowed as a result of temperature or humidity which exceeds the limits for cleaning or painting designated herein, except as approved by the Engineer.

The Contractor shall ensure that all cleaning and painting operations are done in conformance with the coating manufacturer's requirements. A manufacturer's representative shall be present to provide technical assistance during all cleaning and painting operations. The manufacturer shall provide written instructions that include recommendations for cleaning, painting, drying, curing, handling, shipping, and storage of coated steel. These instructions shall be available for review at the pre-painting meeting. The manufacturer's representative shall provide monthly written certification as to the Contractor's conformance with the manufacturer's requirements. If there is a conflict between the manufacturer's requirements and those specified herein, the conflicts shall be resolved at the pre-painting meeting and the Engineer shall be the final judge as to which requirements shall prevail.

Full compensation for services of the manufacturer's technical representative shall be considered as included in the contract price paid for the various items of work involved and no separate payment will be allowed therefor.

#### **APPLICATION**

Application of coatings shall be done in conformance with the requirements of SSPC-PA 1.

Fresh, potable water with a maximum chloride content of 75 mg/L and a maximum sulfate content of 200 mg/L shall be used for water rinsing or pressure washing operations. Water shall be single use. No continuous recycling of rinse water will be permitted. If rinse water is collected into a tank and subsequent testing determines that the collected water conforms to specified requirements, reuse may be permitted at the discretion of the Engineer, as long as no collected water is added to the tank after sample collection for determination of conformance to specified requirements. Water from water rinsing operations shall not be permitted to enter the bay, fall on public traffic, flow across shoulders or lanes occupied by public traffic, or to flow into gutter or other drainage facilities. Water rinsing is defined as a pressurized water rinse with a minimum nozzle pressure of 35 MPa and a minimum flow rate of 15 liters per minute.

Prior to submitting the Painting Quality Work Plan (PQWP) required herein, a pre-painting meeting between the Engineer, the Contractor's QCM, a representative from each entity performing painting for this project, and a representative from the manufacturer to provide the paint, shall be held to discuss the requirements for the Painting Quality Work Plan.

Prior to performing any painting or paint removal, the Contractor shall submit to the Engineer, in conformance with the provisions in "Working Drawings," of these special provisions, 3 copies of a separate Painting Quality Work Plan (PQWP) for each item of work for which painting or paint removal is to be performed. As a minimum, each PQWP shall include the following:

- A. The name of each entity performing painting or paint removal.
- B. One copy each of all current "SSPC: The Society for Protective Coatings" specifications or qualification procedures, and one copy of all ASTM Standards which are applicable to the painting or paint removal to be performed. These documents shall become the permanent property of the Department.
- C. A copy of the manufacturer's guidelines and recommendations for cleaning, painting, drying, curing, handling, shipping, and storage of the product.
- D. Proposed methods and equipment to be used for any paint application.
- E. Proof of each of any required certifications, SSPC-QP 1, SSPC-QP 2, SSPC-QP 3, AISC SPE.
- F. Proposed methods to control environmental conditions in accordance with the manufacturer's recommendations and these special provisions.
- G. Proposed method to protect the product during curing, shipping, handling, and storage.
- H. Proposed rinse water collection plan.
- I. For all coatings, the PQWP shall contain the manufacturer's written recommendations on chloride testing methods, maximum allowable chloride levels, and surface preparation.
- J. A detailed paint repair plan for the repair of damaged areas both in the field and the shop.
- K. A procedure for containing blast media and water during application of finish coats and/or repair of coating of erected steel.

The Engineer shall have 14 calendar days to review the PQWP submittal after a complete plan has been received. No painting or paint removal shall be performed until the PQWP for that work is approved by the Engineer.

It is expressly understood that the Engineer's approval of the Contractor's PQWP shall not relieve the Contractor of any responsibility under the contract for the successful completion of the work in conformity with the requirements of the plans and specifications. The Engineer's review shall not constitute a waiver of any of the requirements of the plans and specifications nor relieve the Contractor of any obligation thereunder, and defective work, materials, and equipment may be rejected notwithstanding review of the PQWP.

## **CLEANING**

Exposed new metal surfaces, except where galvanized or metallized, shall be dry blast cleaned in conformance with the requirements in Surface Preparation Specification No. 10, "Near White Blast Cleaning," of "SSPC: The Society for Protective Coatings." Blast cleaning shall leave surfaces with a dense, uniform, sharp angular anchor pattern of not less than 40 µm nor more than 86 µm as measured in conformance with the requirements in ASTM Designation: D 4417.

Mineral and slag abrasives used for blast cleaning steel shall conform to the requirements in Abrasive Specification No. 1, "Mineral and Slag Abrasives," of "SSPC: The Society for Protective Coatings" and shall not contain hazardous material. Mineral and slag abrasives shall comply with the requirements for Class A, Grade 2 to 3 as defined therein.

Steel abrasives used for blast cleaning steel surfaces shall comply with the requirements of SSPC-AB 3, "Newly Manufactured or Re-Manufactured Steel Abrasives" of "SSPC: The Society for Protective Coatings". If steel abrasive is recycled through shop or field abrasive blast cleaning units, the recycled abrasive shall conform to the requirements of SSPC-AB 2 "Specification for Cleanliness of Recycled Ferrous Metallic Abrasives" of "SSPC: The Society for Protective Coatings". The abrasive size and type shall be selected and maintained so as to achieve the required surface profile.

A Certificate of Compliance conforming to the provisions in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications and a Material Safety Data Sheet shall be furnished prior to use for each shipment of blast cleaning material for steel.

The inside surfaces of bolt holes shall be cleaned in conformance with the requirements in Surface Preparation Specification No. 1, "Solvent Cleaning," of the "SSPC: The Society for Protective Coatings," and visible rust shall be removed.

Abrasive blast cleaned surfaces shall be tested by the Contractor for soluble salts in conformance with the requirements in SSPC: The Society for Protective Coatings Technical Update No. 4, "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates" and cleaned, if necessary, so that the maximum level of chlorides does not exceed the lesser of the coating manufacturer's written recommendations or 10 micrograms per square centimeter. Areas of abrasive blast cleaned steel shall be tested for chlorides at the rate of one test per 200 square meters or part thereof at locations chosen by the Engineer. If chloride levels exceed the maximum allowed by these special provisions, the entire 200 square meter area represented by the testing will be rejected. The Contractor shall perform additional cleaning and testing of rejected areas until chloride levels conform to these requirements.

Chloride testing of abrasive blast cleaned steel may be waived by the Engineer if the steel has not been manufactured, transported or stored in a marine or salt-containing environment. A salt-containing environment includes roads or highways where deicing salts have been used.

#### **MATERIAL ANOMALIES**

Corners shall be chamfered to remove sharp edges.

Chamfering is defined as a process by which a sharp corner is flattened by passing a grinder or other suitable device along the corner, normally in a single pass.

Preparation of Thermal Cut Edges – Thermal cut edges (TCEs) to be painted shall be conditioned before blast cleaning,

Edge conditioning is defined as very shallow grinding or other pre-blast cleaning preparation of thermal cut edges (TCEs) to remove a thin, hardened layer left by resolidification.

Base Metal Surface Irregularities –All visually evident surface defects shall be removed in accordance with ASTM A 6 or AASHTO M 160 prior to blast cleaning steel. When material defects exposed by blast cleaning are removed, the blast profile must be restored by either blast cleaning or by using mechanical tools in accordance with SSPC-SP 11.

#### **PAINTING**

Blast cleaned surfaces shall receive a single undercoat of inorganic zinc primer and, unless otherwise specified, a single finish coat of an inorganic thermosetting hybrid coating based upon a polysiloxane resin co-reacted or blended with an epoxy, acrylic, or urethane resin or combination thereof supplied by the manufacturer of the inorganic zinc coating.

The single undercoat shall consist of an inorganic zinc coating conforming to the requirements in AASHTO Designation M 300, Type I- or Type II, except that: 1) the first 3 sentences of Section 5.6, "Primer Field Performance Requirements," shall not apply for Type II coatings and the entire Section 5.6.1 shall not apply for either type of inorganic zinc coating.

If the Contractor proposes a Type I coating, the Contractor shall furnish to the Engineer for approval documentation as required in Section 5.6 of AASHTO Designation M300. The Contractor shall allow the Engineer 30 working days to review the proposal.

If the Contractor proposes to use a Type II coating, the coating shall be selected from the qualified products list, which may be obtained from the Transportation Laboratory.

The inside surfaces of bolt holes shall be maintained free from visible corrosion until final assembly or recleaned prior to assembly so as to remove all visible corrosion. The inside surface of bolt holes that are not sealed by bolts or washers shall be painted with two applications of a zinc rich primer (organic vehicle type) after completion of all applications of the undercoat of inorganic zinc on adjacent steel. If rust staining on coated surfaces occurs, all stains shall be completely removed by abrasive blast cleaning and reapplication of primer to specified requirements prior to application of finish coats. Finish coats are not required for the inside surfaces of bolt holes.

Inorganic zinc coating shall be used within 12 hours of initial mixing.

Application of inorganic zinc coating shall conform to the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications.

Inorganic zinc coating shall not be applied when the atmospheric or surface temperature, or relative humidity does not conform with the manufacturer's published application requirements. The single undercoat of inorganic zinc coating shall be applied to the required dry film thickness in 2 or more applications within 8 hours of the beginning of blast cleaning. Abrasive blast cleaned steel shall not be exposed to relative humidity exceeding 85% prior to application of inorganic zinc coating. No significant time needs to elapse between the two paint applications. A commonly used procedure to satisfy this requirement is to apply horizontal passes with 50% overlap, followed by vertical passes with 50% overlap.

The total dry film thickness of all applications of the inorganic zinc undercoat, including the surfaces of outside existing members within the grip under bolt heads, nuts and washers, shall be not less than 90  $\mu\text{m}$  nor more than 150  $\mu\text{m}$ , except that the total dry film thickness on each faying (contact) surface of high strength bolted connections shall be between 25  $\mu\text{m}$  and the maximum allowable dry film thickness as determined by certified testing in conformance with Appendix A of the "Specification for Structural Joints Using ASTM A325 or A490 Bolts" of the Research Council on Structural Connections (RCSC Specification). Unless otherwise specified, all coatings used on faying surfaces shall meet the slip coefficient requirements for a Class B coating on blast-cleaned steel, as specified in the RCSC Specification. The Contractor shall provide results of certified testing showing the maximum allowable dry film thickness for the Class B coating from the qualifying tests for the coating he has selected, and shall maintain the coating thickness on actual faying surfaces of the structure at or below this maximum allowable coating thickness.

Areas where mudcracking occurs in the inorganic zinc coating shall be blast cleaned and repainted with inorganic zinc coating to the specified thickness.

Dry spray, or overspray, as defined in the Steel Structures Painting Manual, Volume 1, "Good Painting Practice," of the "SSPC: The Society for Protective Coatings," shall be removed prior to application of subsequent coats or final acceptance. Removal of dry spray shall be by screening or other methods that minimize polishing of the inorganic zinc surface. The dry film thickness of the coating after removal of dry spray shall be in conformance with the provisions for applying the single undercoat, as specified herein.

The inorganic zinc coating shall be tested for adhesion, hardness and chlorides. All tests shall be done in the presence of the Engineer or his designated representative unless otherwise directed by the Engineer in writing. Additional testing as defined in this section shall also be required for water borne inorganic zinc and solvent borne inorganic zinc coatings. The Engineer will determine the locations of the tests. The Contractor shall determine the sequence of the rinsing and testing operations. At the Contractor's expense, satisfactory access shall be provided to allow the Engineer to determine the location of the tests.

The following tests shall be performed on both water borne inorganic zinc primers and solvent borne inorganic zinc primers:

1. Adhesion

The inorganic zinc coating shall have a minimum adhesion to steel of 4 MPa. Testing shall be performed at a minimum frequency of 1 test per 100 square meters of painted area using a self-aligning adhesion tester in conformance with the requirements in ASTM Designation: D 4541. The Contractor, at the Contractor's expense, shall: (1) verify compliance with the adhesion requirements, (2) furnish test results to the Engineer, and (3) repair the coating after testing.

2. Chlorides and Water Rinsing

Except as approved by the Engineer, a minimum time of 72 hours shall be allowed between application of inorganic zinc coating and water rinsing.

All areas of inorganic zinc coating, where finish coats are specified, shall be water rinsed in conformance with the requirements in Section 59-1.03 "Application," of the Standard Specifications and these special provisions. Areas of the coating that are removed by the water rinsing shall be reapplied in conformance with the provisions for applying zinc-rich coating in Section 59-2.13, "Application of Zinc-Rich Primer," of the Standard Specifications and these special provisions.

All areas of inorganic zinc coating where finish coats are to be applied shall be tested by the Contractor for soluble salts in conformance with the requirements in SSPC: The Society for Protective Coatings Technical Update No. 4, "Field Methods for Retrieval and Analysis of Soluble Salts on Substrates" and cleaned, if necessary, so that the maximum level of chlorides does not exceed the lesser of the manufacturer's written recommendations or 10 micrograms per square centimeter. Areas of inorganic zinc coating shall be tested for chlorides at the rate of one test per 200 square meters or part thereof at locations chosen by the Engineer. If chloride levels exceed the maximum allowed by these special provisions, the entire 200 square meter area represented by the testing will be rejected. The Contractor shall perform additional cleaning and testing of rejected areas until chloride levels conform to these requirements.

Finish coat shall be applied to areas passing the chloride tests within 48 hours.

3. Hardness

Prior to application of finish paint, the inorganic zinc coating shall exhibit a solid, hard, and polished metal surface when firmly scraped with the knurled edge of a quarter. Inorganic zinc coating that is powdery, soft, or does not exhibit a polished metal surface, as determined by the Engineer, shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

**Additional Requirements for Water Borne Inorganic Zinc Primers**

1. Steel painted with water borne inorganic zinc primer shall be protected at all times from water immersion conditions during curing, shipping, and storage until the surface pH, measured as described herein, is less than or equal to 7, and until the coating passes the solvent insolubility test described below. Water immersion conditions are defined as standing water or continuous contact with wet materials for periods in excess of 30 minutes. The Contractor, at the Contractor's expense, shall repair damage caused due to immersion conditions by blast cleaning and repainting with inorganic zinc coating to the specified thickness.
2. The surface pH of the inorganic zinc primer shall be tested by wetting the surface with de-ionized water for a minimum of 15 minutes and no longer than 30 minutes and applying pH paper with a capability of measuring in increments of 0.5 pH units. At least two surface pH readings shall be taken for each 50 square meters or portion thereof. If less than 50 square meters of steel is coated in a single shift or day, at least two surface pH readings shall be taken for primer applied during that period. Application of finish coats will not be permitted until the surface pH is less than or equal to 7.
3. Dry to solvent insolubility for water borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D4752, "Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub" except that water shall be the solvent. The resistance rating shall not be less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 50 square meters or portion thereof. Inorganic zinc coating that does not meet the solvent insolubility requirement shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

The Contractor shall maintain suitable enclosures to protect the inorganic zinc coating from damage caused by the environment until the coating passes these tests and is fully cured per the manufacturer's written recommendations.

### **Additional Requirements for Solvent Borne Inorganic Zinc Primers**

1. Dry to solvent insolubility for solvent borne inorganic zinc primers shall be determined in conformance with the requirements in ASTM Designation: D4752, "Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (Inorganic) Zinc-Rich Primers by Solvent Rub." The resistance rating shall not be less than 4. Areas of inorganic zinc coating shall be tested for solvent insolubility at the rate of one test per 50 square meters or portion thereof. Inorganic zinc coating that fails to meet the solvent insolubility requirement shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.
2. Surface hardness of solvent borne inorganic zinc shall be a minimum 2H when measured in conformance with the requirements in ASTM Designation D3363, "Standard Test Method for Film Hardness by Pencil Test." Areas of inorganic zinc coating shall be tested at the rate of one test per 50 square meters or portion thereof. Areas failing to meet the 2H pencil hardness require additional time to cure. Inorganic zinc coating that fails to meet the surface hardness requirement shall be repaired by the Contractor, at the Contractor's expense, by blast cleaning and repainting with inorganic zinc coating to the specified thickness.

The Contractor shall maintain suitable enclosures to protect the inorganic zinc coating from damage caused by the environment until the coating passes these tests and is fully cured per the manufacturer's written recommendations.

### **Finish Paint**

Except as noted, exterior surfaces of undercoated areas and bolts shall receive a single finish coat of an inorganic thermosetting hybrid coating based upon a polysiloxane resin co-reacted or blended with an epoxy, acrylic, or urethane resin or combination thereof supplied by the manufacturer of the inorganic zinc coating. The coating shall not contain any isocyanate or polyisocyanate components. Exterior surfaces are defined as steel surfaces undercoated with inorganic zinc which are visible in the finished work from the outside of the bridge.

The surface of the undercoat that is to be covered shall be free from moisture, visible dust, visible grease, or other deleterious materials immediately prior to application of finish paint.

Galvanized or metallized surfaces designated to receive finish paint shall be cleaned in accordance with the requirements of SSPC-SP 1 and then primed with a galvanized surface primer recommended by the manufacturer of the polysiloxane finish paint. The complete finish paint system on galvanized fasteners shall have a minimum adhesion rating of 4 when measured in accordance with ASTM D 3359.

Finish coats will not be required on exterior surfaces receiving an overlay.

Finish coats are not required on interior surfaces. Interior surfaces are defined as steel surfaces undercoated with inorganic zinc not visible from the outside of the bridge and include, but are not limited to, the inside surfaces of the box girder, crossbeams and tower shafts.

At the Contractor's option, the finish coat shall be applied in accordance with one of the following two methods:

1. Field applied after meeting the requirements of these special provisions.
2. Shop coated after meeting the manufacturer's recommendations regarding curing of the inorganic zinc primer, meeting the finish coat manufacturer's recommendations for application over primed surfaces, and meeting the requirements of these special provisions.

The finish coat shall be applied within 48 hours following water rinsing and passing the chloride testing as specified previously in this section. Chloride testing prior to shop application of finish coats may be waived by the Engineer if the steel has not been transported or stored in a marine or salt-containing environment. A salt-containing environment includes, but is not limited to, roads or highways where deicing salts have been used.

The finish coat paint shall be formulated for application to inorganic zinc coating and shall conform to the following:

Exposure Test	Exposure Time	Measurement Test/ Minimum Criteria	
		Color Retention per ASTM D 2244 (Color change in $\Delta E^*$ )	Maximum Gloss Reduction from Original Reading per ASTM D 523
Accelerated Weathering <sup>c</sup> (ASTM D 4587, Cycle 2)	4,000 hours	<2.0	10%
TEST METHOD		CRITERIA	
Solvent resistance (ASTM D 5402)	100 double rubs with MEK	No visible topcoat on cloth, No softening (ASTM D 3363)	
Adhesion to primed steel (ASTM D 4541, Type III, IV or V)		Minimum 5 Mpa. Adhesion greater than 4 Mpa satisfies this requirement if failure is in primer.	
Adhesion to galvanized steel (ASTM D 3359, Procedure A, surface cleaned per SSPC-SP 1 and primed with manufacturer's recommended galvanized surface primer)		Minimum 4 A	
Dry-Through (or Dry-To-Handle) Time (ASTM D 1640)		8 hours maximum	
Abrasion Resistance (ASTM D 4060), 1000 cycles, CS17 wheel, 1 Kg load		< 0.125 g loss	
Mandrel Bend (ASTM D 522, Method B), 125µm dry film applied to abraded steel plate		No cracking on 12.7 mm mandrel	
Water Resistance (ASTM D 870), 125µm dry film on primed steel, cured 7-days.		No change in color or gloss after 7-days. Adhesion greater than 4 Mpa after 48-hours recovery	

The finish coat shall be applied in 2 applications. The first application shall consist of a spray applied mist application. The second application shall be applied after the mist application has dried to a set to touch condition as determined by the procedure described in Section 7 of ASTM Designation: D1640. The finish coat color shall match Federal Standard 595B No. 26408. The total dry film thickness of both applications of the finish coat shall be not less than 125 µm.

The total dry film thickness of all applications of inorganic zinc coating and finish coat paint shall be not less than 200 µm nor more than 325 µm.

### Handling, Storage, and Erection

Due care shall be exercised in handling the steel in the shop, during shipping, during erection, and during subsequent construction of the bridge. The steel shall be insulated from the binding chains by softeners approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be spaced in such a way that no rubbing that may damage the coatings will occur during shipment. The steel shall be stored on pallets at the job site or by other means approved by the Engineer, so that it does not rest on the dirt, so that water pockets are not formed, and so that components do not fall or rest on each other. All shipping and job site storage details shall be submitted for approval in the PQWP.

## **Field Repair of Damaged Areas**

Field repair painting shall comply with all provisions specified in the special provisions, and the following:

Damaged areas of paint and areas which do not comply with the requirements of this specification shall have the paint removed and all defects corrected. The steel shall then be blast cleaned to a near white condition to produce a profile of between 1.0 to 3.5 mils [25 to 90  $\mu\text{m}$ ]. This profile shall be measured immediately prior to the application of the undercoat to ensure that the profile is not destroyed during the feathering procedure. All abrasive blasting and painting shall be done as specified herein.

The existing paint must be feathered to expose a minimum of 13 mm of each coat. During the re- application of the paint, care must be used to ensure that each coat of paint is only applied within the following areas. The undercoat shall only be applied to the surface of the bare steel and the existing undercoat, which has been exposed by feathering. The finish coat shall not extend beyond the areas which have been feathered or lightly sanded. All repairs shall be made in a manner to blend the patched area with the adjacent coating. The finished surface of the patched area shall have a smooth even profile with the adjacent surface. The first repair area shall be used as a test section and no more repairs made until the methods are approved by the Engineer. Finish coat repairs shall be applied by either brush or spray. Damaged paint which will be inaccessible for coating after erection shall be repaired and recoated prior to erection.

## **PAYMENT**

Payment for clean and paint structural steel shall conform to the provisions in Section 59-2.16, "Payment," of the Standard Specifications and these special provisions.

Cleaning and painting structural steel, of the types listed in the Engineer's Estimate, will be paid for on the basis of lump sum price.

Full compensation for water rinsing and conforming to the requirements for testing outlined in these special provisions, including providing access for testing and repairing painted surfaces, and for services of the manufacturer's technical representative shall be considered as included in the contract lump sum price paid for clean and paint structural steel of the types listed in the Engineer's Estimate and no additional compensation will be allowed therefor.

#### 10-1.64 CLEAN AND PAINT CABLE SYSTEM

This work shall consist of surface preparation and painting of the cable system as shown on the plans, in accordance with the provisions in Section 59, "Painting," of the Standard Specifications and these special provisions.

The cable paint system shall be applied to the wire wrapped main cable, cable strand sockets, cable strand anchor rods, shims and nuts, cable bands, cable band bolts, cable band caulking, saddles, cable shrouds, suspender ropes, suspender rope sockets, suspender rope separators, suspender rope anchor rods and nuts, split colors, elastomeric collars, keeper angles, keeper bolts, shims, suspender clamps, handropes, handrope stanchions, handrope supports, handrope gates, handrope anchors, and appurtenances in accordance with the manufacturer's recommendations and these special provisions.

A qualified representative of the manufacturer shall be present for the test demonstration, and for at least 3 days at the beginning of the application and at completion of the application. The manufacturer's representative shall certify to the Engineer in writing that the proper installation procedures are being followed, including, but not limited to the following:

- A. Surface preparation.
- B. Type of equipment used.
- C. Mixing of the material components.
- D. Method of application, and finish.

Handling, mixing and addition of thinners or any other material shall be performed in accordance with the manufacturer's recommendations and with prior approval of the Engineer.

The cable paint system shall not be applied when weather or surface conditions, as determined by the Engineer, are such that the material cannot be properly handled, applied, and cured within the specified time.

The Contractor shall perform a test demonstration, in the presence of the Engineer and the manufacturer's representative, of all cable paint system application procedures to be used. The test demonstration shall consist of surface application and painting of two adjacent cable bands and the main cable between them. The Contractor shall notify the Engineer at least 20 working days prior to the test demonstration.

#### MATERIALS

The cable paint system shall consist of a primer, a two intermediate coat Noxyde Plus paint system, or equal, and a finish coat. The Noxyde Plus cable paint system shall be manufactured by the following supplier:

VENDOR ADDRESS AND PHONE NUMBER
MARTIN MATHYS S.A. KOLENBERG 23 3545 ZELEM/HALEN BELGIUM

The primer shall be a waterborne, single component acrylic coating with highly elastic polymers that cure to a highly elastic, seamless rubber coating. The primer shall be Pegalink or equal.

The two intermediate coats shall be 100 percent Noxyde Plus.

The finish coat shall be a water-borne, single component semi-gloss acrylic paint. The finish coat shall be Pegacryl or equal.

The primer, intermediate coats, and finish coat shall be three different colors. The finish coat color shall match Federal Standard 595B, No. 26408. Color samples shall be submitted to the Engineer for approval 60 working days prior to the start of painting.

Each shipment of cable paint system materials shall be accompanied by a Certificate of Compliance as provided in Section 6-1.07, "Certificates of Compliance," of the Standard Specifications. The certificate shall state that the materials and fabrication involved comply in all respects to the specifications and data submitted in obtaining approval, and shall include the type of paint products used and the application rates of all components of the cable paint system. The first shipment shall include a copy of the manufacturer's quality assurance program listing all in-house testing criteria.

Copies of Material Safety Data Sheets (MSDS) for all materials shall be kept on site for review by the Engineer.

The Contractor shall be responsible for the workmanship and performance of the installed cable paint system. The cable paint system shall be applied by a manufacturer certified applicator.

The primer for the cable paint system shall conform to the following physical requirements:

Property	Test	Requirement
Weight of Solids	ASTM Designation: D2369	48% $\pm$ 2%
Specific Gravity		1.2 $\pm$ 0.03
Volume of Solids	ASTM Designation: D2697	45.4% $\pm$ 2%
Elasticity		200% Elongation
Water Resistance		100%
Alkali Resistance		Fair
Salt Spray Resistance		100%
Water Vapor Transmission	ASTM Designation: E96	15g H <sub>2</sub> O/m <sup>2</sup> in 24 hours
Chemical Resistance	10% Acid solution	Fair

The intermediate coats of the cable paint system shall conform to the following physical requirements:

Property	Test	Requirement
Weight of Solids	ASTM Designation: D2369	67% $\pm$ 2%
Specific Gravity		1.26 $\pm$ 0.02
Volume of Solids	ASTM Designation: D2697	57% $\pm$ 2%
Elasticity	CSTB No. 15.381	200% Elongation
Water Resistance		12 mo. Immersion, no change
Alkali Resistance		No damage from Na(OH) at pH = 14
Salt Spray Resistance	CSTB No. 15.381	100%
Water Vapor Transmission	ASTM Designation: E96	5.5g H <sub>2</sub> O/m <sup>2</sup> in 24 hours
Chemical Resistance	25% mineral acid solution	Excellent
UV Ray Resistance		100% against outdoor exposure
Shore A Hardness		70
Aging and Adhesion		Unaffected after 8 hours, 60°C to -20°C with rain, frost, UV light and humidity
Sulfur Dioxide Resistance		100% resistance
Ozone Resistance		No cracking or embrittlement when subjected to 1 PPM ozone for 30 days
Hot water immersion		No effect after 1000 hours in 38°C water
Impact Resistance	DIN 51155	90 N
Tensile Adhesion	CSTB (France)	47.5 An/cm <sup>2</sup>
Sand Blasting Resistance	DIN 51155	Unaffected at 20,000 shots

A minimum of four ounces of polyolefin beads conforming to the properties in the following table shall be added to each gallon of finish coat applied to horizontal or walking surfaces. The beads shall be added to the finish coat prior to application and be thoroughly dispersed into the coating during normal mixing procedures. The cured finish coat, following addition of polyolefin beads, shall have a minimum average slip-resistance of 0.50 when wet as determined in accordance with ASTM Designation: F 1679. Additional beads shall be added if the average slip-resistance fails to meet this requirement as determined by the Contractor's independent laboratory upon testing of a sample of the finish coat. A copy of the slip-resistance testing results shall be furnished to the Engineer prior to application of finish coat.

Property	Requirements
Composition	Polyethylene or Polypropylene or a combination thereof
Appearance	White free-flowing powder
Size	210 to 300 $\mu$ m
Specific Gravity	0.90
Initial Melt/Softening point	-6°C
Final Melt Point	166°C
Flash Point	greater than 275°C

The Contractor shall verify by testing that all properties are met. The physical properties shall be verified by an independent laboratory approved by the Engineer.

All material components of the cable paint system shall be supplied to the job site in the manufacturer's unopened packaging. Material for the cable paint system in opened or damaged containers shall not be used and shall be removed from the job site at the Contractor's expense.

All material components of the cable paint system shall be stored in cool, dry conditions, between 5°C and 20°C, out of direct sunlight and in accordance with the manufacturer's recommendations and Health and Safety regulations.

## CLEANING

The main cables, suspender ropes, and handropes shall be cleaned in accordance with the provisions of Surface Preparation Specification No. 1, "Solvent Cleaning," of the SSPC: The Society for Protective Coatings. All traces of the zinc waterproofing paste applied to the main cable wires which has bled through the exterior wire wrapping shall be removed. Solvent cleaning shall be supplemented by hand tool cleaning in accordance with the provisions of Surface Preparation Specification No. 2, "Wire Brushing, and Hand Washing, and Rinsing," of the SSPC: The Society for Protective Coatings to remove any non-adherent shop applied coating, or detrimental foreign matter unable to be removed by solvent cleaning. Brass wire brushes shall be used for this surface preparation. Steel wire brushes will not be permitted.

Handrope stanchions, cable shrouds, and the surfaces of cable bands, saddles, and other items which are not in contact with the main cable or are metallized, shall be dry blast cleaned in the shop in accordance with the provisions of Surface Preparation Specification No. 10, "Near White Blast Cleaning," of the SSPC: The Society for Protective Coatings. Blast cleaning shall leave all surfaces with a dense, uniform, angular, anchor pattern of no less than 40  $\mu$ m as measured in accordance with the requirements of ASTM Designation: D 4417.

All steel surfaces to be coated with the Noxyde Plus cable paint system shall be cleaned to remove all oil, dirt, rubber, dust, and other material which would prevent proper bonding to and curing of the primer.

Within 72 hours of wire wrapping of the main cable, and prior to application of the primer, the main cable shall be securely wrapped with a waterproof film to protect from salt air. The waterproof film shall not be removed sooner than 72 hours prior to application of the primer. Solvent and hand cleaning, as described in this section, will not be permitted as a substitute for placement of waterproof film.

Immediately prior to the application of any component of the Noxyde Plus system, the receiving surface shall be dry and all remaining dust or loose particles shall be removed by blowing with clean, dry, oil free air.

## **PAINTING**

Primer shall be applied within 4 hours of the completion of surface preparation. All locations showing evidence of contamination, as determined by the Engineer, shall be recleaned at the Contractor's expense. The Engineer shall be the sole judge of the need for recleaning.

Primer shall be applied in accordance with the manufacturer's recommendations. The primer shall be spray applied in a fine even spray so as to produce a uniform coating. The dry film thickness of the primer shall be between 35 µm and 50 µm.

Primer shall be applied in the shop to the handrope stanchions, cable shrouds, and the surfaces of cable bands, saddles, and other items which are not in contact with the main cable or are metallized.

Surfaces painted with primer shall be protected from damage. Should damage to the primer occur, as determined by the Engineer, the surface shall be repaired at the Contractor's expense prior to application of the intermediate coats.

The primer shall cure before application of the intermediate coats. The Engineer with the assistance of the manufacturer's representative at the job site shall determine when the cure is adequate to continue.

The intermediate coats shall be applied within 24 hours of the application of primer, weather permitting, except for the handrope stanchions, cable shrouds, and the surfaces of cable bands and saddles. All undercoat surfaces showing evidence of contamination, as determined by the Engineer, shall be cleaned. The Engineer shall be the sole judge of the need for recleaning.

The two intermediate coats shall be applied in accordance with the manufacturer's recommendations. The two intermediate coats shall be spray applied in a fine even spray so as to produce a uniform coating. The total dry film thickness of the two intermediate coats shall be between 200 µm and 350 µm.

The two intermediate coats shall cure before application of the finish coat. The Engineer with the assistance of the manufacturer's representative at the job site shall determine when the cure is adequate to continue.

The finish coat shall be applied within 24 hours of the application of intermediate coats, weather permitting. All locations showing evidence of contamination, as determined by the Engineer, shall be cleaned in accordance with the manufacturer's recommendations.

The application of the intermediate coats and the finish coat shall not be made if rain is forecast within 6 hours of application, or as determined by the Engineer. The finish coat shall be applied only when the atmospheric and steel temperatures are above 10°C and the relative humidity is below 85 percent, and these conditions are forecast to be maintained for a minimum of 6 hours. The temperature of the main cable shall be at least 3°C above the dew point.

The finish coat shall be applied in accordance with the manufacturer's recommendations. The finish coat shall be applied to produce a uniform coating. The dry film thickness of the finish coat shall be between 35 µm and 50 µm. The total dry film thickness of all coats shall be between 270 µm and 450 µm. The color of each coat shall be uniform throughout the entire member.

The Contractor shall check wet film thickness at least once every 10 square meters using a gauge pin or standard comb type thickness gauge.

The painted surface shall be checked for visible pinholes and other surface defects. The paint system shall provide a smooth, pinhole free continuous film on all coated surfaces.

In the event that any materials are damaged during this work due to the Contractor's operations, the Contractor shall repair or replace the damaged materials at the Contractor's expense, and as approved by the Engineer.

## **MEASUREMENT AND PAYMENT**

Clean and paint cable system will be measured and paid for on a lump sum basis.

The contract lump sum price paid for clean and paint cable system shall include full compensation for furnishing all labor, materials, tools, equipment and incidentals, including the services of the manufacturer's representative as specified herein, and for doing all the work involved in clean and paint cable system, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

# ENGINEER'S ESTIMATE

04-0120F4

## ALTERNATIVE 1

Item	Item Code	Item	Unit of Measure	Estimated Quantity	Unit Price	Item Total
61	BLANK					
62	BLANK					
63	BLANK					
64 (S)	BLANK					
65	BLANK					
66 (S-F)	520102	BAR REINFORCING STEEL (BRIDGE)	KG	1 410 000		
67 (S-F)	520110	BAR REINFORCING STEEL (EPOXY COATED) (BRIDGE)	KG	140 370		
68 (F)	550203	FURNISH STRUCTURAL STEEL (BRIDGE)	KG	183 000		
69 (F)	550204	ERECT STRUCTURAL STEEL (BRIDGE)	KG	183 000		
70 (F)	049314	FURNISH STRUCTURAL STEEL (BRIDGE)(TOWER)	KG	13 095 000		
71 (F)	049315	ERECT STRUCTURAL STEEL (BRIDGE)(TOWER)	KG	13 095 000		
72 (F)	049316	FURNISH STRUCTURAL STEEL (BRIDGE)(TOWER STRUT)	EA	68		
73 (F)	049317	FURNISH STRUCTURAL STEEL (BRIDGE) (BOX GIRDER)	KG	29 065 000		
74 (F)	049318	ERECT STRUCTURAL STEEL (BRIDGE) (BOX GIRDER)	KG	29 065 000		
75 (F)	049319	FURNISH STRUCTURAL STEEL (BRIDGE) (BIKEPATH)	KG	1 273 000		
76 (F)	049320	ERECT STRUCTURAL STEEL (BRIDGE) (BIKEPATH)	KG	1 273 000		
77 (S-F)	049321	FURNISH STRUCTURAL STEEL (BRIDGE) (SADDLE)	KG	1 130 000		
78 (F)	049322	ERECT STRUCTURAL STEEL (BRIDGE)(SADDLE)	KG	1 130 000		
79 (S-F)	049323	FURNISH AND INSTALL SHEAR KEY (PIER E2)	EA	2		
80 (F)	049324	FURNISH STRUCTURAL STEEL (BRIDGE) (PIPE BEAM)	KG	260 000		

# ENGINEER'S ESTIMATE

04-0120F4

## ALTERNATIVE 2

Item	Item Code	Item	Unit of Measure	Estimated Quantity	Unit Price	Item Total
61	BLANK					
62	BLANK					
63	BLANK					
64 (S)	BLANK					
65	BLANK					
66 (S-F)	520102	BAR REINFORCING STEEL (BRIDGE)	KG	1 410 000		
67 (S-F)	520110	BAR REINFORCING STEEL (EPOXY COATED) (BRIDGE)	KG	140 370		
68 (F)	550203	FURNISH STRUCTURAL STEEL (BRIDGE)	KG	183 000		
69 (F)	550204	ERECT STRUCTURAL STEEL (BRIDGE)	KG	183 000		
70 (F)	049314	FURNISH STRUCTURAL STEEL (BRIDGE)(TOWER)	KG	13 095 000		
71 (F)	049315	ERECT STRUCTURAL STEEL (BRIDGE)(TOWER)	KG	13 095 000		
72 (F)	049316	FURNISH STRUCTURAL STEEL (BRIDGE)(TOWER STRUT)	EA	68		
73 (F)	049317	FURNISH STRUCTURAL STEEL (BRIDGE) (BOX GIRDER)	KG	29 065 000		
74 (F)	049318	ERECT STRUCTURAL STEEL (BRIDGE) (BOX GIRDER)	KG	29 065 000		
75 (F)	049319	FURNISH STRUCTURAL STEEL (BRIDGE) (BIKEPATH)	KG	1 273 000		
76 (F)	049320	ERECT STRUCTURAL STEEL (BRIDGE) (BIKEPATH)	KG	1 273 000		
77 (S-F)	049321	FURNISH STRUCTURAL STEEL (BRIDGE) (SADDLE)	KG	1 130 000		
78 (F)	049322	ERECT STRUCTURAL STEEL (BRIDGE)(SADDLE)	KG	1 130 000		
79 (S-F)	049323	FURNISH AND INSTALL SHEAR KEY (PIER E2)	EA	2		
80 (F)	049324	FURNISH STRUCTURAL STEEL (BRIDGE) (PIPE BEAM)	KG	260 000		